INTERAVIA

REVIEW OF WORLD AVIATION

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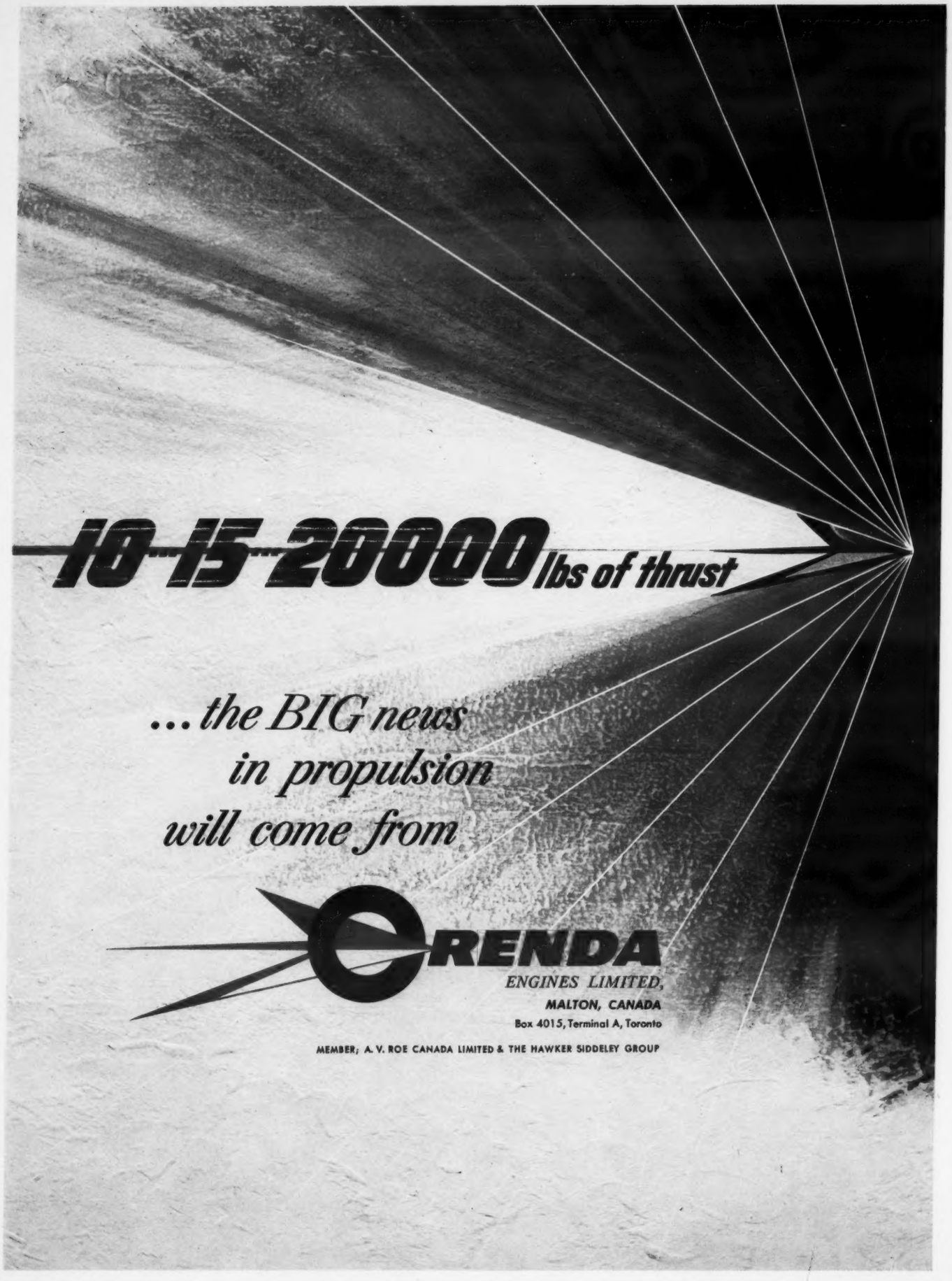
Integration - the Imperative for Defence

VOLUME XI 2 FEBRUARY 1956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INTERAVIA

Review of World Aviation

Volume XI No. 2 February 1956

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Front Cover:

The air defence forces of Western Europe are concentrated in a very narrow space and can expect only very brief warning periods. The latest interceptors of French and British design therefore have mixed propulsion (rocket motors and turbo-jets). They are designed to attack their main target—the high-flying bomber—in a supersonic climb and destroy it by means of rocket salvoes. The cover picture shows the prototype of S.N.C.A. du Sud-Ouest's SO.9000 Trident.

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BELGIAN WORLD AIRLINES

Around the World

New Jet Airliner Fleets Will Fly With Pratt & Whitney Engines

Leading U.S. and foreign airlines have ordered fleets of Douglas and Boeing jet transports which will be able to cross the Atlantic nonstop in either direction. These airlines include Pan American World Airways, United Air Lines, National Airlines, American Airlines, KLM Royal Dutch Airlines, Braniff International Airways, Continental Air Lines, and Eastern Air Lines. As this is being written additional orders are expected shortly.

The jet airliners will go into service starting in 1958, cutting flying times about in half. Both transports ordered, the Douglas DC-8 and the Boeing 707, will use jet engines designed, developed, and produced by Pratt & Whitney Aircraft.

Shown above is the JT3 turbojet engine, which will power many of the new jet airliners. The JT3 is rated at 10,000 pounds of thrust. Since 1953 its military counterpart, the J-57, has accumulated many thousands of hours of proven performance in military aircraft. A new, advanced Pratt & Whitney Aircraft engine, the JT4, also will be used in the jet airliners. Both are of twin spool, axial-flow design.

with United Aircraft

IN ANTARCTIC COLD AND AFRICAN HEAT Sikorsky helicopters are proving their versatility and dependability. They fly in remote areas and under harsh operating conditions, such as in the far North, the Malayan jungles, and the tropics. At left, an S-55 of the U.S. Navy hovers over the deck of the cutter *Eastwind* prior to embarking with the U.S. expedition to the Antarctic. At right, another S-55 is guarded by an African soldier while carrying the Lederle-Sikorsky Medical Expedition from Leopoldville to Nairobi. The helicopter flew 2800 miles with the expedition, which distributed drugs and collected medical data.

GUIDED MISSILES such as this TM-61 *Matador* of the U.S. Air Force impose a severe test on the reliability and precision of all components. Even though no pilot is aboard, the missile is air-conditioned so the delicate apparatus can operate properly. The air conditioning system on the *Matador* is made by Hamilton Standard, which also makes equipment for the *Nike*, a U.S. Army anti-aircraft missile. Hamilton Standard, known throughout the world for the manufacture of the finest aircraft propellers, also produces equipment for 40 different types of turbine-powered aircraft.

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European Offices : 3/5 Warwick House Street, London SW1, England

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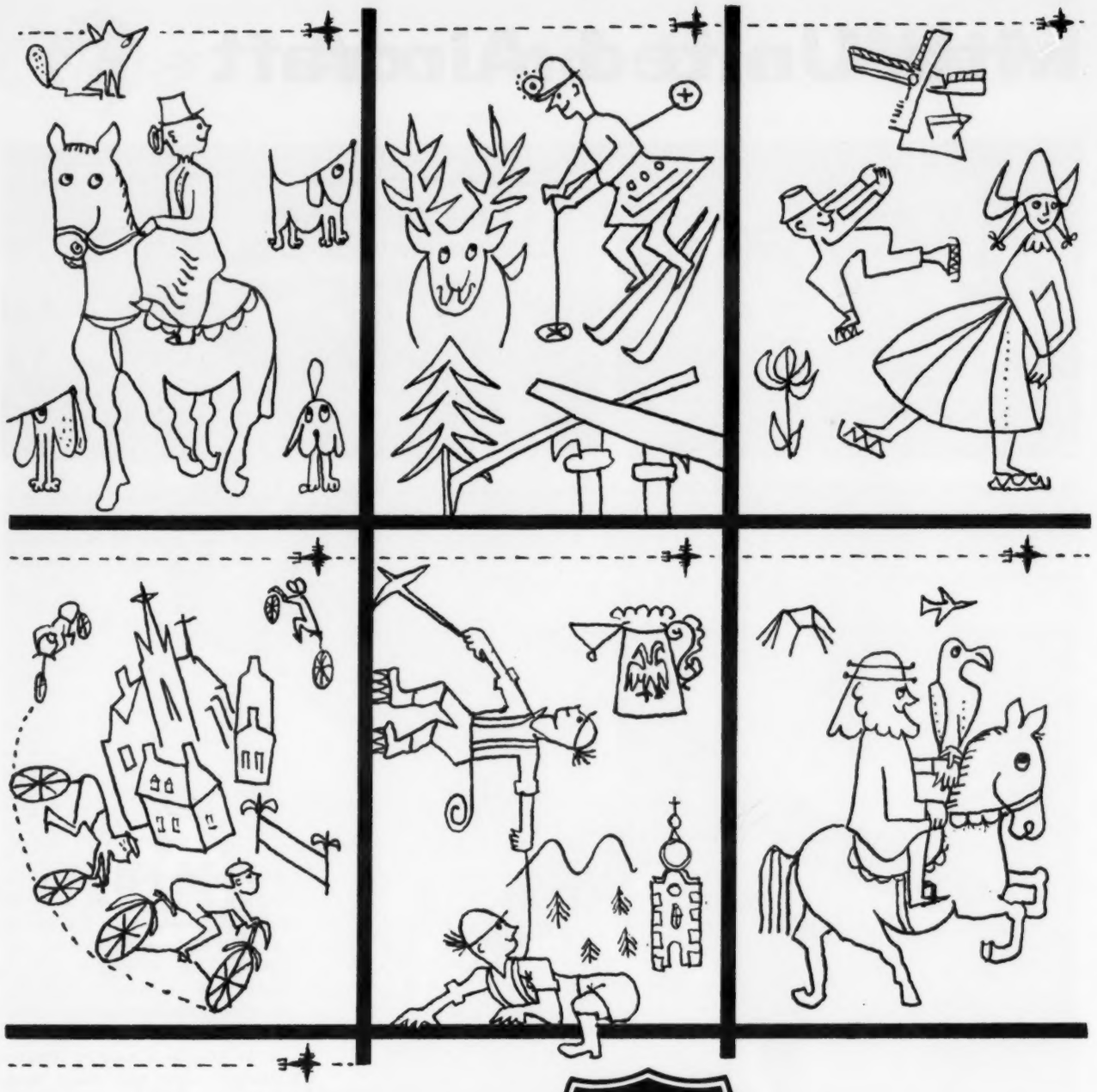

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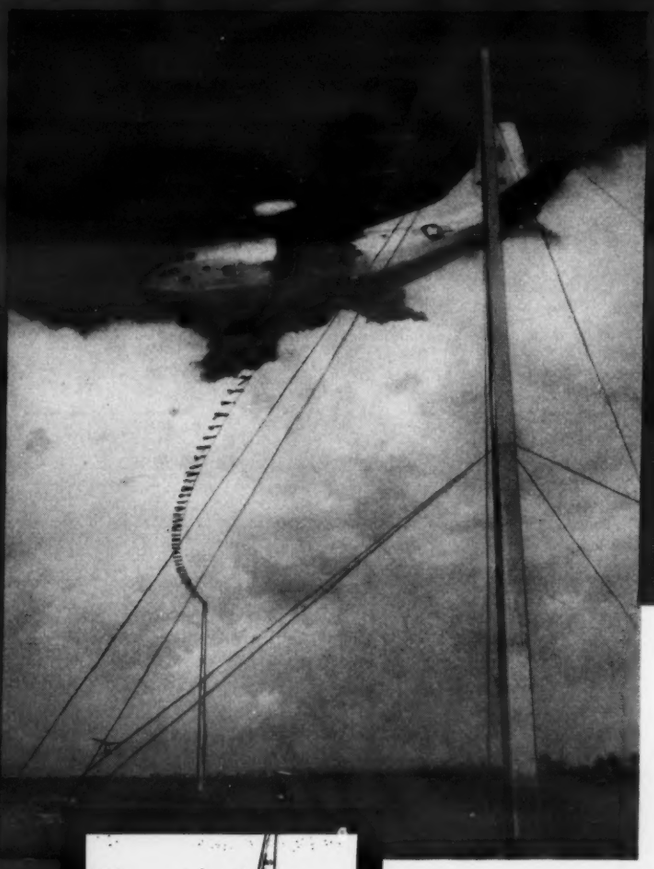

THROUGH THE SCHOOL OF HARD KNOCKS WITH FLYING COLORS!

The Fairchild C-123 was especially designed for landings and take-offs on rough, unprepared fields.

Litter patients, airborne troops or almost 10 tons of bulk equipment may be airlifted by the C-123. A built-in ramp facilitates *quick loading and unloading of cargo and troops.*

During "Operation Shakedown", the C-123 was subjected to 500 hours of rugged duty under all operational conditions.

FAIRCHILD C-123 PASSES OPERATIONAL SUITABILITY TESTS

Now being subjected to rugged tests for the U. S. Air Force, the Fairchild C-123 Assault Transport has proved it can withstand the rigors of any combat airlift mission and win an "A" for top performance!

Shown above is an actual photograph of a C-123 making a short field landing downwind over a 50-foot obstacle on a sandy, deeply rutted strip at Eglin Air Force Base. During other tests the C-123 was flown in simulated front line combat airlift missions and proved its durability by landing and taking off on extra rough terrain in the shortest possible distance.

The Fairchild C-123 is literally built to "take it tough" on any assigned Air Force mission . . . another example of the rugged, hard-job dependability built into Fairchild utility and logistics aircraft.

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Passengers on these aircraft can make use of two small drawing rooms, decorated in fine woods, where they can relax or play bridge.

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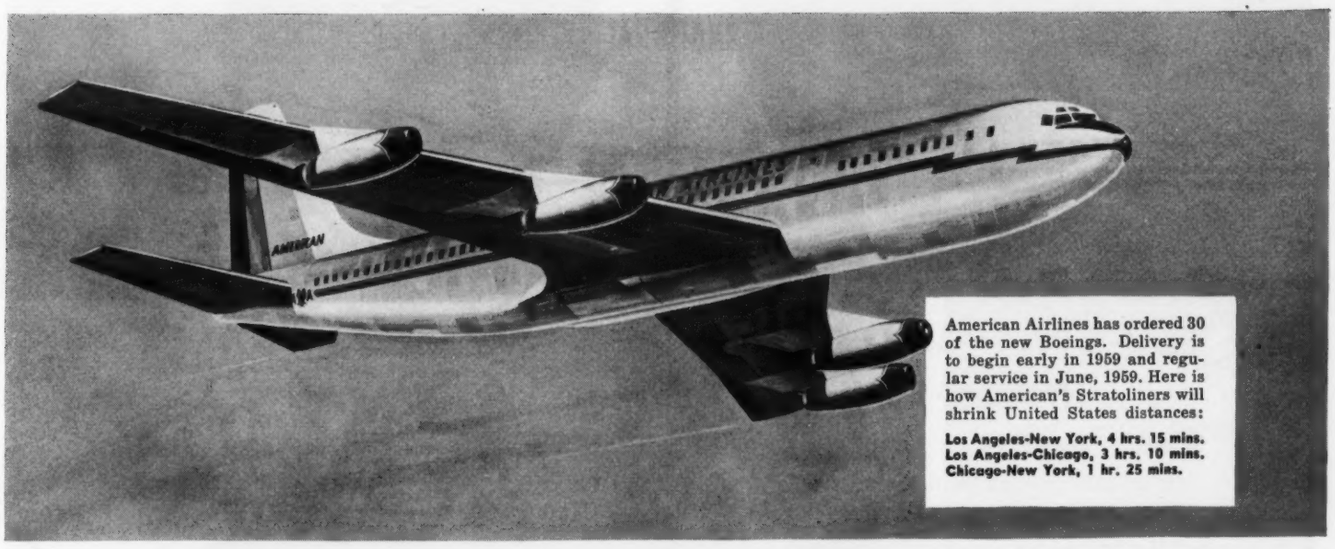
Pan American World Airways has ordered 20 Boeing 707 Stratoliners, for delivery late in 1958, and scheduled service the following spring. Here are some of the proposed flight times:

New York-Paris, 6 hrs. 35 mins.
Chicago-London, 6 hrs. 45 mins.
San Francisco-Tokyo, 12 hrs. 45 mins.
N. Y.-Buenos Aires, 11 hrs. 15 mins.

FIRST jet transocean service!



American Airlines has ordered 30 of the new Boeings. Delivery is to begin early in 1959 and regular service in June, 1959. Here is how American's Stratoliners will shrink United States distances:

Los Angeles-New York, 4 hrs. 15 mins.
Los Angeles-Chicago, 3 hrs. 10 mins.
Chicago-New York, 1 hr. 25 mins.

FIRST jet transcontinental service!

There is only one *first* jet transport in America. It is the Boeing Stratoliner—an airplane with brilliant performance that has already been proved in more than a year of flight-testing. On a recent routine test flight, the Boeing Jet made history by flying from coast to coast *and back* in 8 hours and 6 minutes!

You will be flying in Boeing jet airliners *first* because Boeing was the one manufacturer with the faith and foresight to build a prototype—the "707"—with its own funds.

Behind the Stratoliner is 39 years of leadership in aviation—20 years of building high-altitude pressurized planes—and finally the vast experience Boeing has gained in producing and flying more big multi-jet, high-altitude aircraft than any other company in the world.

BOEING Jet Stratoliner

For your winter sports holiday

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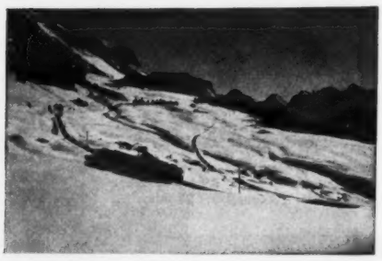
Ready for the Races in the Alpes vaudoises.

Oh boy ! What a view on the Mont-Blanc (highest peak in Europe) and the French Alps. Shot from the Swiss Jura.

Can you imagine how happy these two people feel ? The " Suger cake " is the Matterhorn (Alpes valaisannes).



On the sunny side of good old Earth. This train will take you right into the heart of the Jungfrau (Bernese Oberland).

And here is the way to climb a mountain without getting tired. In front of the majestic Mont-Blanc, French Savoy.

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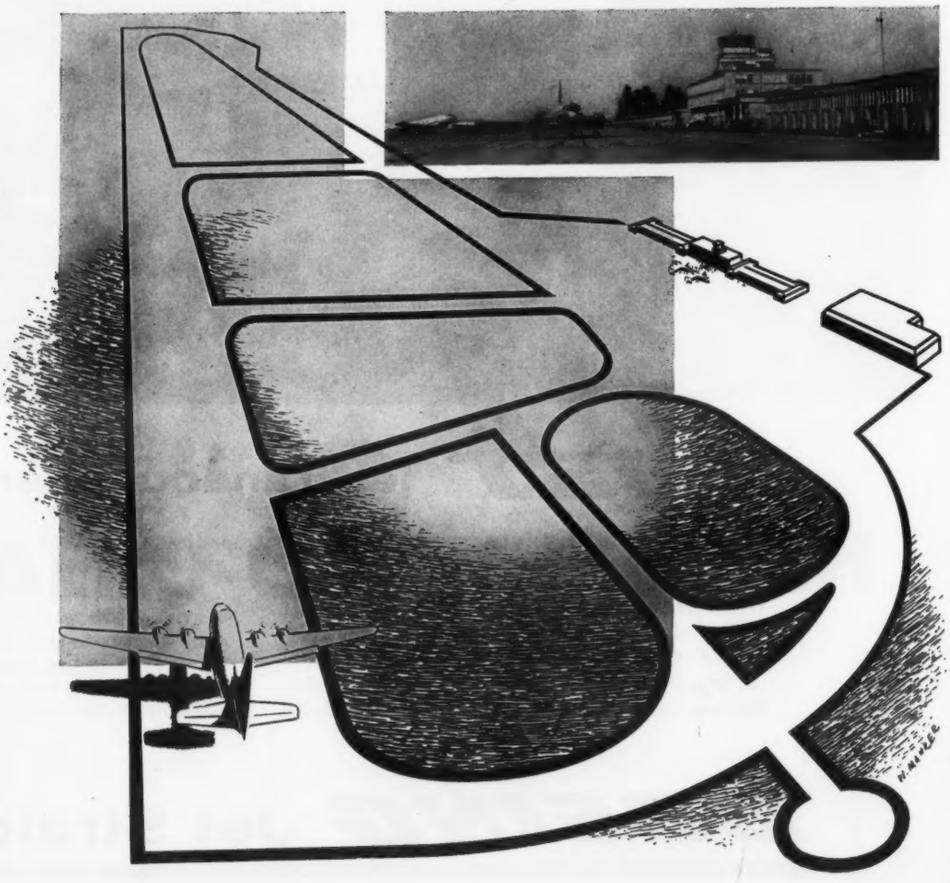
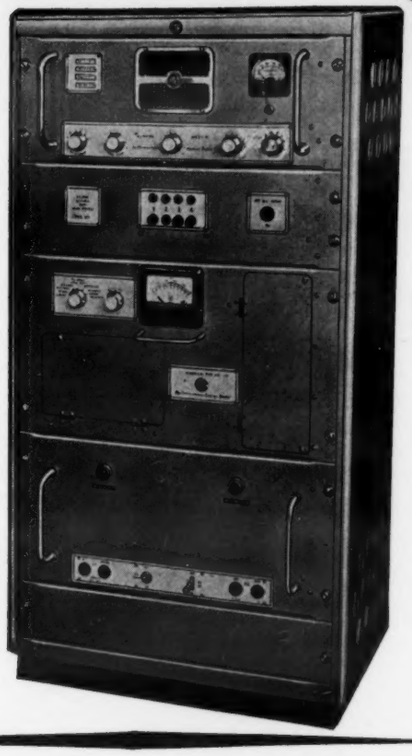


AN OUTSTANDING PAIR



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1·6—14 Mc/s

Newly designed to use the most modern valves and components available, this station incorporates local or remote push-button selection of up to four channels, remote control being possible to a distance of 15 miles.

50-WATT V.H.F. FIXED STATION

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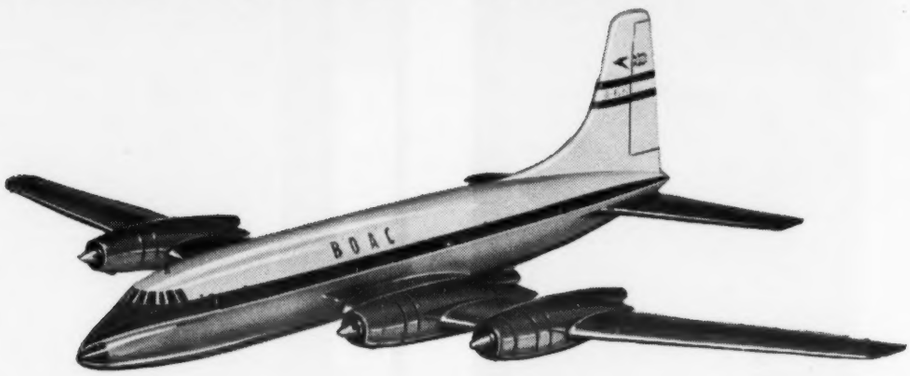

The contract has now been signed between EKCO ELECTRONICS and B.O.A.C. under which the corporation's entire fleet of Bristol *Britannias* will be fitted with Ekco Airborne Search Radar. This follows the news that Ekco Search Radar brought safer flying to the *Britannia* on its recent route-proving flights.

Ekco Airborne Search Radar not only gives pilots long-distance warning of cumulo-nimbus cloud formation and high-ground, but also provides the navigator with map-painting facilities. Special features of this 3-cm. equipment are iso-echo contour circuits and high brightness display.

EKCO *electronics*

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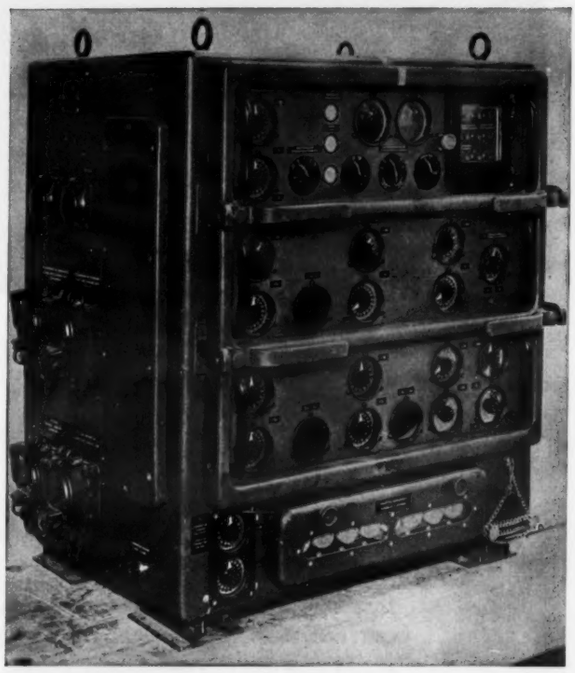
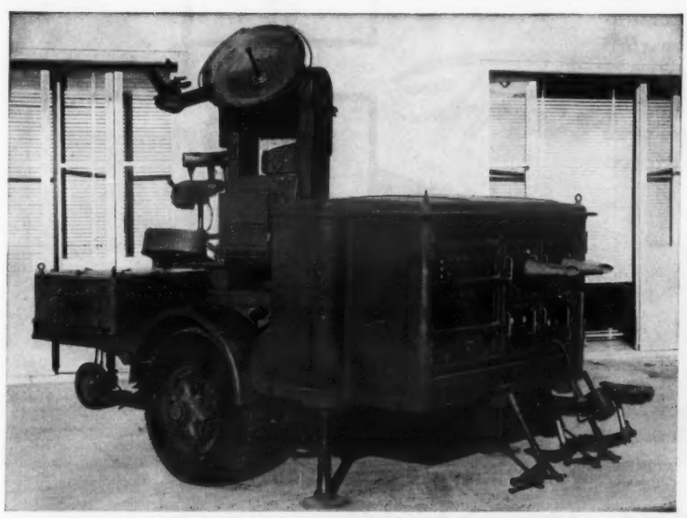


PARALLAX COMPUTER

between search and fire control radar



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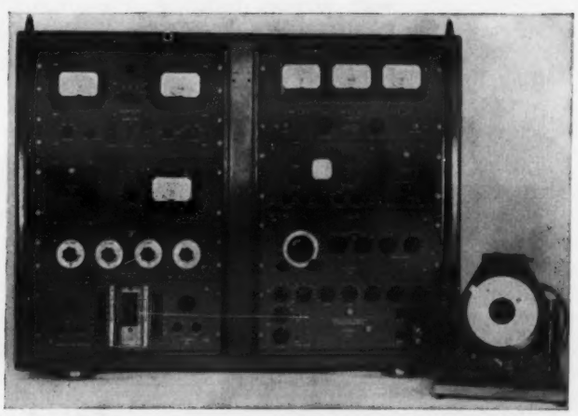

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Rubber covered series transformer

High intensity approach light

Taxiway light

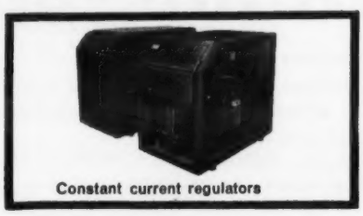
Cleared to land!

Under bad visibility conditions during night or daytime the pilots of aircraft approaching to land must rely on the ground staff of an airport.

Just that extra safety can be obtained if they can also see where they are going.

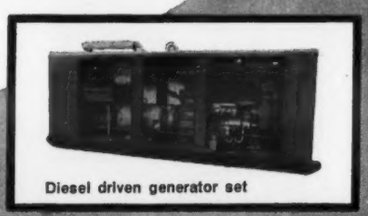
Good and dependable lighting systems are, therefore, one of the essentials of a modern airport, be it civilian or military.

Philips, with their vast experience in the manufacture of all kind of light sources, have thoroughly investigated the problems connected with airport lighting. Philips Airport Lighting Equipment, resulting from this research has been approved by NATO and the American Airforce.



Constant current regulators

High intensity runway light



Diesel driven generator set

PHILIPS

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for dependable Airport Lighting

Friendship

THE FIRST VERSATILE TURBOPROP AIRLINER FOR SHORT AND MEDIUM RANGE TRAFFIC ANYWHERE IN THE WORLD, POWERED BY THE WORLD'S MOST RELIABLE PROPELLER-TURBINE, THE FAMOUS 1600 SHP "DART"

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SOCIÉTÉ D'EXPLOITATION DES MATÉRIELS

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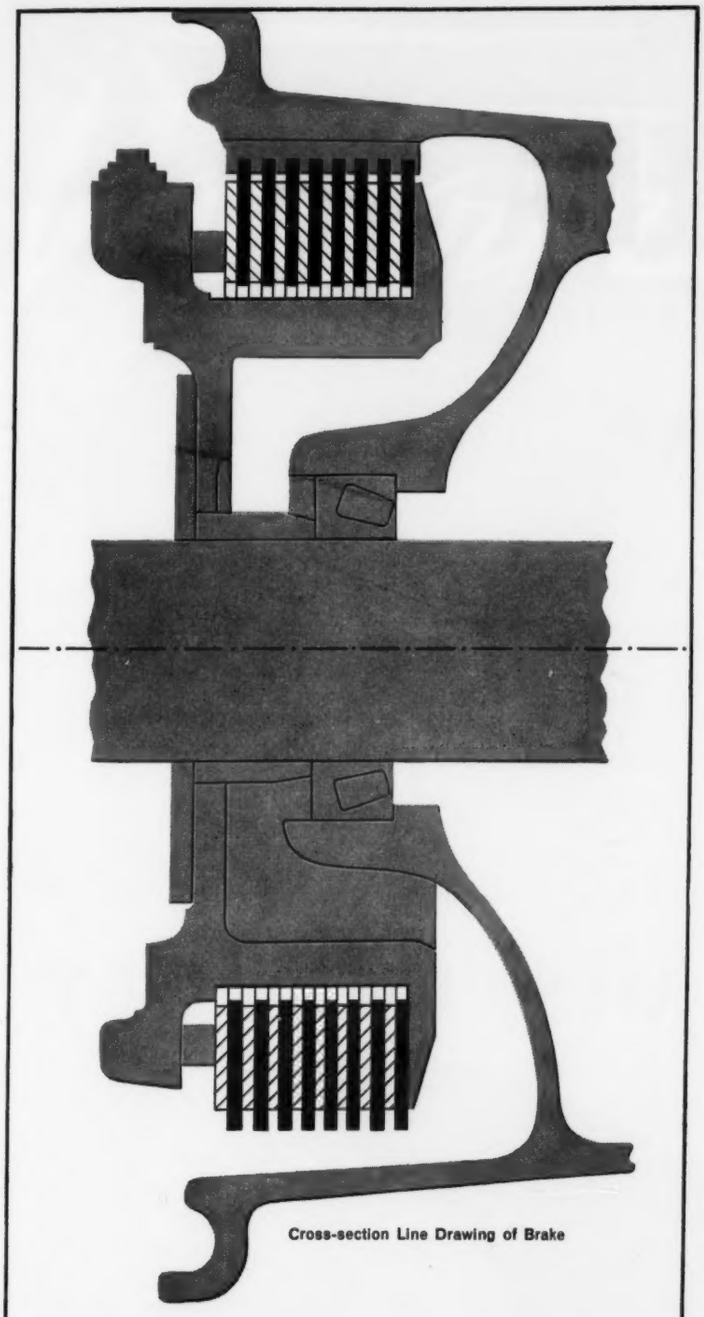

Cross-section Line Drawing of Brake

Typical Disc Cross Section Through Friction Pair

Goodyear proudly announces:

The Tri-metallic Brake

The brake that gives up to 50% increase in absorption of Kinetic Energy per pound of brake

RECOGNIZING the fact that the weight and speed of today's airplanes were fast approaching the limits and capacities of existing aircraft brakes, Goodyear concentrated its skills and resources to pioneer the answer.

The result is The Tri-Metallic Brake: a brake which utilizes a new friction material and new combinations of metals, making a "heat sink" of the lining, its mating member, and the brake structure—thereby greatly increasing the kinetic energy absorption per pound of brake.

The advantages of The Tri-Metallic Brake are spectacular: (1) weight-savings and space-savings that result from the greatly increased efficiency of this new brake design, (2) a new metallic, non-insulating lining which will operate at temperatures up to 70% higher than other designs of this type, (3) low displacement and high torque, giving further economy in weight and space, (4) simplicity of design with greatly reduced number of parts.

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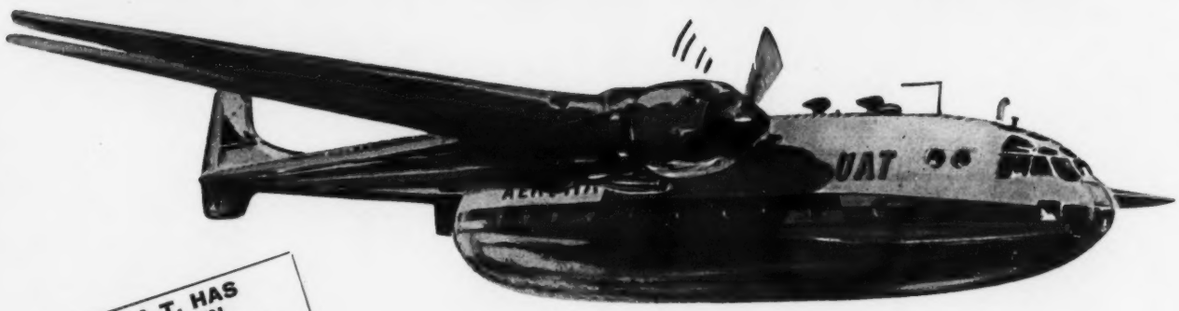
NORECRIN
Même origine...

NORATLAS
... même succès



U.A.T. HAS CHOSEN "NORATLAS"

After a successful trial period, the well-known French airline U.A.T. has ordered a number of Nord 2501s from S.N.C.A.N. for its African services.

Succès d'aujourd'hui
qui s'affirmera...

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INTERAVIA

Deadline Notes

No 2, 1956

I A T A SUMMER TIMETABLES: The 20 I A T A member airlines who provide the bulk of European air services and overseas air connections are planning to offer 20% more passenger seats during the 1956 summer peak season than they did last year, to meet an anticipated further rise in the demand for tourist and business travel. Frequencies will be increased, new cities added to existing networks, and new equipment, including larger helicopters, put into use. New points of call will be at Ankara, Bergen, Bardufoss, Ostende and Venice, and seasonal flights will be resumed to Biarritz, Berne, Dinard, Deauville, Innsbruck, Klagenfurt, Lourdes and Salzburg.

AIR AGREEMENTS TO REMAIN U S PRESIDENTIAL CHORE: The Department of State has asked the Congress to allow President Eisenhower to continue to negotiate air transport agreements with foreign countries, suggesting that to restrict the President's powers in this field would be unconstitutional. The recommendations apparently came in reply to Congressional trends to strip the President of some of his air transport powers. The House Interstate and Foreign Commerce sub-committee is studying two bills which would substantially revise the present aviation laws. Both bills would authorize the Civil Aeronautics Board to suspend any unreasonable rates charged by a foreign carrier and to set minimum rates for U. S. airlines flying overseas.

F.A.I. REGIONAL CONFERENCE: The first regional conference of the Fédération Aéronautique Internationale in Latin America will be held in Mexico City in February under the sponsorship of the Mexican Government. February is to be "Aviation Month" in Mexico, and several aeronautical meetings and a large exhibition are planned.

B.O.A.C. TO FLY TO SAN FRANCISCO: A B O A.C. application to operate services to Detroit and San Francisco from London via New York has been approved by a U.S. Civil Aeronautics Board Examiner. The company's request for permission to inaugurate flights between New York and Nassau has also received favourable consideration.

K.L.M. PLANS LOS ANGELES SERVICE: K.L.M. Royal Dutch Airlines' President General I.A. Aler has confirmed that his company plans to fly a direct service from Europe to Los Angeles by way of Montreal. Aler said he was hopeful that the route proposal will be approved by the U.S. State Department and the Civil Aeronautics Board by April. K.L.M. would then inaugurate bi-weekly flights from Holland within three months. Lockheed L-1049G Super Constellations would be used initially, to be replaced by Douglas DC-7Cs in 1957 and by Douglas DC-8 jets in 1960-61.

"EASTERN EPICUREAN": Air France now offers passengers the opportunity of flying twice a week on the London-Paris-Beirut-Teheran-Karachi-Calcutta-Bangkok-Saigon-Manila-Tokyo route without changing aircraft. The new service, known as the "Eastern Epicurean", is operated by a Super Constellation. On the Saigon-Tokyo lap the aircraft has Japanese stewardesses.

NEW AIRPORT FOR STOCKHOLM: The Swedish Minister of Communications has asked for a preliminary grant of 25,000,000 crowns under the new budget for construction of a large new airport for Stockholm. No decision regarding location has been reached, but Jordbro, south of Stockholm, has been proposed.

BRITISH TRANSPORT AIRCRAFT COMMITTEE: A Committee charged with the study of specifications for the development of future British transport aircraft has been set up under the direct responsibility of the Minister of Supply. Its formation seems to be the result of recent setbacks in British transport aircraft development (Comet, Vickers V 1000). Its job is reported to be to coordinate the requirements of B O A C., B E A., Commonwealth airlines, the R A F. and Commonwealth Air Forces.

"... AND SOME DAY A SUPER CARAVELLE TOO": Georges Héreil, President of Société Nationale de Constructions Aéronautiques du Sud-Est, recently addressed the Aviation Writers Association in New York on the development of the Caravelle. The present version, he said, was only the beginning of a family. "There will be a Caravelle II, a Caravelle III and one day also a Super Caravelle." - On his return to France Héreil stated that the Caravelle is to be demonstrated in the United States in September.

S.N.C.A.S.O. in 1955: Sales registered by Société Nationale de Constructions Aéronautiques du Sud-Ouest during 1955 exceeded the 15,000,000,000 franc mark and were 35 percent higher than in the preceding year.

* From INTERAVIA's world-wide news service, including INTERAVIA AIR LETTER, the daily international aviation news digest. — No part may be reproduced without written permission.

At the end of 1955, the company employed 7800 persons. Production concentrated mostly on the following: the construction of two SO 9050 Trident II prototypes; the pre-production and quantity production of the Vautour and the Djinn; wing units and rear fuselages for the Mystère II and IV in quantity production; ejection seats for all French jet aircraft. The order backlog increased substantially. It includes, among others, the second part of the Vautour quantity production programme which will bring to 140 the number of aircraft of this type supplied to the French Air Force in three versions (ground attack, all-weather fighter and fighter-bomber). SNCASO's subsidiary SFERMA reports that its sales were about the same as in 1954 - in the neighbourhood of 1,000,000,000 francs. This latter company specializes in repairs, overhaul and modification of both civil and military aircraft. In the course of last year, SNCASO acquired a considerable part of the capital of Société Saint-Chamand-Granat which will devote part of its production capacity to the manufacture of special equipment and accessories for the Vautour and the Djinn.

NEW MISSILE PROJECT FOR DOUGLAS: Emphasizing the growing preoccupation of aircraft manufacturers with missile projects, Douglas Aircraft Company has confirmed rumours of a new classified missile project and has appointed the former Assistant Chief Project Engineer, Nike Systems, to be Chief Project Engineer of the new missile. Trade sources say that it will not be an extension of the Nike, but an entirely new concept.

U.S. AIR FORCE LONG-RANGE INTERCEPTOR: Lockheed, North American and Northrop are each working on a long-range interceptor for the U.S. Air Force. The aircraft under study by Lockheed, designated the CL-288, is an entirely new design, "not an aircraft already on the boards", Lockheed officials say. It is to meet approaching high-speed bombers at distances far greater than the capabilities of present fighters. It is expected to work with advance ground and airborne radar stations to intercept enemy aircraft well beyond the United States borders.

NORTHROP-ANAHEIM CHANGES PRODUCTION EMPHASIS: Originally formed in 1951 as a production source for Army Ordnance Corps fire control instruments, Northrop Aircraft's Anaheim, Calif., Division will undergo a major shift in production emphasis to manufacture additional products for all military services, company officials have announced. The broadened scope of production will enable the Division to include manufacturing, research and development activities for the Army, Navy, Air Force and Marine Corps in the fields of optics, armament, guided missiles, airframe components, and other specialized products. To supervise the Division's multi-project programme, James J. Ward has been appointed Production Manager. Ward was formerly Chief of Quality Control at Anaheim.

WORLD-WIDE BUILDING PROGRAMME FOR U.S. FORCES: The U.S. Defense Department has asked Congress to approve a world-wide military construction programme involving $2,012,283,000 during the 1956-57 fiscal year. Of the total, $1,055,281,000 would be spent on construction in the United States, $554,222,000 overseas and $402,780,000 at "classified and unspecified locations".

WORKSHOP BRIEFS

The Vickers-Supermarine N.113 Navy fighter fitted with two Rolls-Royce Avons began flight testing on January 20th. * The Javelin successor built by Gloster will have two Bristol Olympus turbojets (Olympus BOl.6 of 15,000 to 17,000 lbs. thrust?). * A reconnaissance version of the four-jet Vickers Valiant is in production under the designation Valiant B (PR)1. * All B.O.A.C.'s Bristol Britannias will be equipped with Ekco storm-warning radar. * "Springbok Hopper" is the name of a light helicopter with ramjet propulsion which is to be flight tested by the Johannesburg designer Larry Barnett in April or May 1956. * The first Convair F-102B delta-wing fighter will be ready for testing by the autumn. * Two of the three pre-production Baroudeurs ordered have now been completed. They bear the type designation SE 5003 and are fitted with a SNECMA-Atar 101-D 3 turbojet of 6,400 lbs. thrust. The third pre-production model will probably have a more powerful engine. * Douglas announces receipt of a Navy contract for a new version, the AD-7, of the Skyraider. Delivery to begin in August 1956; power plant: one Wright R-3350-26WB. * During its operational testing a twin-jet SO 4050 Vautour of S.N.C.A. du Sud-Ouest covered the 370-mile stretch between Melun-Villaroche and Istres at an average speed of 740 m.p.h. * A prototype of the Agusta-Zappata AZ 8L four-engined commercial transport will be ready for flight testing later this year. The AZ 8L is designed primarily for the needs of domestic traffic. * Canadian Steel Improvement, a subsidiary of A.V. Roe (Canada) Ltd., has developed a process which greatly simplifies and cheapens the forging of precision parts in titanium.

Delays in European Integration — Weaknesses in Air Defence

What is integration ?

The word integration has come into widespread use in recent years to designate the efforts to set up supranational organizations in the economic or political field. The European Coal and Steel Pool is an example of economic integration, while the North Atlantic Treaty Organization, on the other hand, aims at military and political integration.

However, there were three plain indications towards the end of last year that, despite all good intentions, progress with European integration is not as smooth as it might be.

The Council of Europe in Strasbourg called the permanent European Air Transport Conference to a three-week session at the end of November, to seek ways and means of increasing the efficiency of European commercial aviation —not in opposition to, but alongside the United States' powerful air transportation. The negotiations came to nothing, and absolutely no advance was made towards integration.

General Alfred Gruenther, Supreme Allied Commander Europe, announced in October 1955 that the air defence of Western Europe was the weak spot in the West's defence and that the antediluvian organization of the Western European command system was mainly responsible for this state of affairs. In other words, Western European countries have so far refused to integrate their air defence forces.

In his State of the Union Message on January 5th, 1956, President Eisenhower asked Congress to grant additional funds over a long term to encourage Western European nations "to achieve a greater measure of integration."

Such is in broad outline the situation as it presents itself at the beginning of 1956. As the success or failure of integration are not without effect on international economics and politics—and in particular in the aviation field—the situation merits closer examination. As the notion of integration has hitherto been cited most frequently by Germany, it is logical to open such an investigation by an analysis of the situation in West Germany.

The question of German integration

Odysseus and the Fifth Freedom: Among the Editors' New Year mail was a letter reading in part as follows: "...Another year is drawing to a close, air transport is once again flying a few miles an hour faster and once again it is swelling with optimism in its economic development on the threshold of a new air transport era. Strictly speaking we Germans should also be swelling with optimism. But the air in the Federal Republic seems to be less sustaining... A German air transport miracle in 1955? *Niet*..."

Should the writer be dismissed as a discontented pessimist? After all, the *Deutsche Lufthansa* is flying again and is proudly showing its flag over the North Atlantic. It would have been tempting merely to file the letter away, had it not been for the fact that, on December 9th, 1955, the serious German economic paper *Handelsblatt* published a disturbing, unsigned article whose veiled statements had to be read twice. After a second reading it was seen to express the semi-official views of the competent members of the Federal Transport Ministry. Its title was "Odysseus and the Fifth Freedom", and its sub-title asked: "What air transport policy should we follow?"

Somehow even the opening of the article recalled the Hitler epoch. Hitler began all his speeches with an allusion to the birth of the party; the unnamed author of the abovementioned article begins with the birth of the International Civil Aviation Organization and the 1944 Chicago Air Transport Convention.

"...The object of these agreements (with other countries) is to restore the *Lufthansa*— which like Odysseus on his return is no longer master in its own house—to its old rights. The reactivation of the company was justifiable only if it was agreed that it should gradually take over its fair share of the traffic carried to or generated by the Federal Republic. Foreign airlines thus had to be prepared, after the restoration of air sovereignty (to West Germany), for their activity in the market open to them to be restricted or made subject to new provisions, unless their countries had the good fortune to be able to offer a compensatory share in their own traffic volume.

"Why must operating rights immediately be axed, rather than things simply being left to competition?... If things were left to find their own level in practice, it would probably be found that the *Lufthansa* as the youngest and by a long way the weakest partner would suffer

No sign of integration in European air transport... The session of the Permanent European Air Transport Conference held in Strasbourg in December 1955 produced no tangible results. Left to right: H. Bouché (France's delegate to I.C.A.O.), P. J. M. Nottet (head of the Belgian delegation and Conference Chairman), E. Weld (I.C.A.O. Secretariat).

Progress in the integration of European air defence is painful... The following German delegation took part in the Atlantic Council meeting in Paris in December 1955 (left to right): Foreign Minister H. von Brentano, Defence Minister T. Blank, General Speidel, N.A.T.O. representative H. Blankenhorn. — The meeting set up four air defence regions but no central command.

the heaviest loss... But United States airlines would also probably be dissatisfied with such an expansion of supply, as the agreement between the two countries (United States and Federal Republic) is based on a redistribution of rights by the Federal Republic. Otherwise we should scarcely have received such far-reaching concessions in the United States. All existing bilateral agreements would lose their value if we Germans should start giving away our rights...

"... Only joint action can lead out of today's bilateralism. This is the question which has been occupying the European Air Transport Conference of Strasbourg for the past two years ...

"As the partners from Scandinavia recognize the objective weakness of their position, they have thrown everything possible on to their side of the balance. They talked of liberalization ..., constructed a connection between air transport and trade policies—so far more or less unique in the world—and mobilized personal contacts. Nobody will take this amiss, as such things are part and parcel of the political game and should not disturb a shrewd bargainer. This is why the effect on some of our ministries was so striking. For instead of agreeing after joint consultation on a line backed by all—whatever such a line might turn out to be—they amused themselves with broadsides ... We do not believe that the air transport agreement with the Scandinavian countries is acceptable to us in its latest draft."

What had happened? The outsider would understand very little unless he recalled certain historical facts.

In June 1955, after the restoration of German sovereignty, the West German Federal Republic negotiated in Washington an air transport agreement which was then signed in July. This agreement caused surprise in Europe and aroused considerable opposition in the United States. For the Germans it was extremely favourable, since they received extensive rights to fly to and across the United States. For the Americans, too—or at any rate for those airlines that fly east—the agreement was undeniably advantageous. From the European point of view, West Germany was helping to introduce a kind of Trojan Horse into the European area in the form of the super-powerful U.S. airlines. On the American side the rights could come into effect immediately with the existing air fleets and personnel. For the Germans they are at present merely a note on the future, since the *Lufthansa* lacks the aircraft and the pilots to take any really efficient part in world air transport. — According to the author of the *Handelsblatt* article, however, there appear to be a number of undisclosed additional agreements, for he states expressly that the Americans "might take it amiss if supply on the German market were not restricted."

The same situation probably applies to the bilateral Anglo-German air transport agreement concluded in London in July 1955: "Quid pro quo," as the article states, rights based on compensations, also still only on paper as far as the Germans are concerned. At any rate the British Corporations are permitted to operate to a number of German cities, and the *Lufthansa* may call, in some cases on its overseas services, at Manchester, Glasgow and London, as well as in Nigeria on services to Africa and at Singapore and Hong Kong on routes to the Far East.

The Franco-German agreement brought home from Paris in October 1955 reads almost like a pool agreement. The authorization it gives to call at Paris on overseas services seems to be unique, since similar concessions have hitherto been steadfastly refused to other European airlines. Whether the Saar problem was also touched upon during the negotiations is an open question—the article in *Handelsblatt* describes such mixtures of general politics with air transport politics as "somewhat unique so far"—, but some kind of additional clauses appear to exist, because ...

As is proved by the unsuccessful German-Scandinavian air transport talks held in Bonn from November 3rd to 18th, 1955, officials of the Federal Transport Ministry have been trying to clear the German air somewhat overenthusiastically. To quote the same article again, they "evidently seized the ax." S.A.S. was offered landing rights at provincial Han-

ALADDIN'S WONDER LAMP
OR THE GERMAN AIR TRANSPORT AGREEMENTS

The leading men of the Aviation Department of Bonn's Ministry of Transport are—there cannot be the slightest doubt—more than just able civil servants. You can imagine the feelings of their colleagues in other countries when they learned of the success the German negotiators had scored during 1955 in Washington, London and Paris. This success almost looked like magic—did the gentlemen from Bonn carry Aladdin's Wonder Lamp in their travelling bags, the lamp you have only to rub in order to make all your wishes come true?

Joking apart: to an outsider the three air transport agreements which the Germans concluded in 1955 read almost *too* beautifully and too simply. As a result, a host of whispers, guesses, rumours and speculation has inevitably been going the rounds—what is really behind these agreements? There must be secret clauses, for only these would explain the almost uncomfortably generous concessions made by the three countries to the Germans. Rumours of this sort have reached these editorial offices from numerous capitals in Europe. Why all this secrecy? At the risk of a denial, let us hear the gist of some of the speculation.

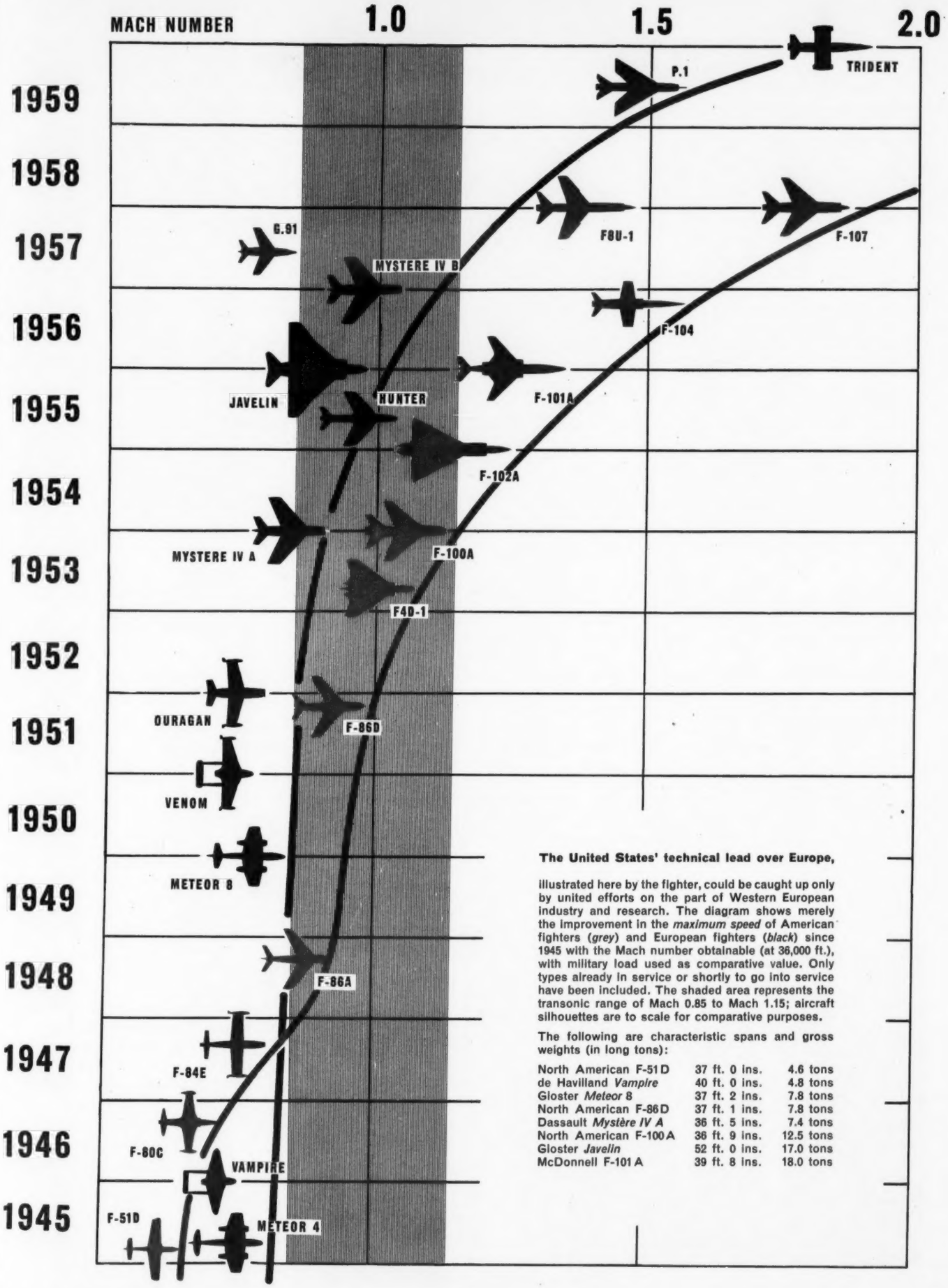
It is known that at the moment Lufthansa collaborates intimately with Trans World Airlines which has given the German company technical assistance and the first Atlantic air crews. But who knows ... perhaps Lufthansa will change horses tomorrow and hitch its wagon to TWA's competitor, the big Pan American World Airways? Who knows ... perhaps TWA will have to withdraw from the North Atlantic in 1960, because so far it has not joined the airlines who have ordered the first two hundred big American jet transports? Who knows ... perhaps Pan American has reserved for Lufthansa something like a half-dozen aircraft of its "wholesale" order for 45 jetliners—at least informally? For TWA it certainly has not reserved any, or what do you think?

And now give free rein to your imagination for a moment. Just assume that in 1960 TWA were forced to retire from the Atlantic owing to its lack of competitive equipment. Air France, Sabena, KLM-Royal Dutch Airlines, SAS and all the others would still impatiently be waiting for their first big jet aircraft. But Pan American and its ally Lufthansa ... they would be flying jet-propelled! They would not fly between New York and Frankfurt alone—both of them could land also in Paris and elsewhere under the rights given them in their air agreements. Pan American and Lufthansa could simply corner the North Atlantic market for a while ...

Air France, on the other hand, who agreed to Lufthansa's serving Paris on its North and South Atlantic runs, would not be absolutely happy. But why has this concession been granted to the German negotiators, although it has consistently been refused to other European airline companies? Merely because of their beautiful eyes or their personal charm? One humourist has said that the gentlemen from the *Bundesverkehrsministerium* promised the French the whole of the Saar, without strings. This may be accurate or not. More likely is that the German talking partners promised the French in their mutual interest to clear the German skies of K.L.M., S.A.S. and Sabena and to weaken these bothersome friends a little in Central Europe. Could this be true?

All this leaves you pensive, and K.L.M. and S.A.S. probably have been so for some time. For, if they had not had ominous forebodings concerning their rights to serve German cities, they would hardly have shown such fiery zeal in cooperating with the newly-born Air Austria. Suppose Frankfurt or Hamburg were closed to the Dutch and the Scandinavians—well, they would still have Vienna. And a very charming city, too. And the Southeast European travel reservoir can also be quite useful for overseas operations.

Well, we probably shall have that denial very shortly. The gentlemen of Bonn's Ministry of Transport have done more than just implement an air policy. This is great politics, almost statesmanship. At least, that's what it looks like at the moment.



The United States' technical lead over Europe,

illustrated here by the fighter, could be caught up only by united efforts on the part of Western European industry and research. The diagram shows merely the improvement in the *maximum speed* of American fighters (*grey*) and European fighters (*black*) since 1945 with the Mach number obtainable (at 36,000 ft.), with military load used as comparative value. Only types already in service or shortly to go into service have been included. The shaded area represents the transonic range of Mach 0.85 to Mach 1.15; aircraft silhouettes are to scale for comparative purposes.

The following are characteristic spans and gross weights (in long tons):

North American F-51 D	37 ft. 0 ins.	4.6 tons
de Havilland *Vampire*	40 ft. 0 ins.	4.8 tons
Gloster *Meteor* 8	37 ft. 2 ins.	7.8 tons
North American F-86 D	37 ft. 1 ins.	7.8 tons
Dassault *Mystère IV A*	36 ft. 5 ins.	7.4 tons
North American F-100 A	36 ft. 9 ins.	12.5 tons
Gloster *Javelin*	52 ft. 0 ins.	17.0 tons
McDonnell F-101 A	39 ft. 8 ins.	18.0 tons

over instead of Hamburg, on the North Atlantic route, and Nuremberg instead of Frankfurt en route to South America. The Scandinavians clearly knew enough economic geography to realize how much good this would do them.

Talks with the Swiss, Belgians, Dutch and Italians are scheduled for January, February and March 1956. Swissair is a major airline, but not an essentially disturbing factor, as its interests are modest and clearly defined. The position of the Dutch and Belgians appears to be more difficult, as K.L.M. and Sabena operate world-wide networks. Are they threatened with the ax?

All this is highly controversial. The Paris treaties of 1955, on which Germany's regained sovereignty is based, also cover questions of commercial aviation, mention liberalization under I.C.A.O. and insist that discrimination be avoided. The notion of liberalization should not be over-estimated, but it does look as if the Scandinavians regard the treatment they have received as somewhat discriminatory, compared with the German air agreements with the United States, Britain and France.

And as the unnamed writer in the *Handelsblatt* speaks of "broadsides from another Federal ministry," it may perhaps be assumed that the German Foreign Ministry, as signatory to the Paris treaties, does not altogether agree with the Federal Transport Ministry's attitude.

So much for "Odysseus and the Fifth Freedom."

In actual practice the *Deutsche Lufthansa,* in its present organization and that planned for the near future, has achieved nothing more with these unusually favourable agreements than a "paper network." It is neglecting domestic European traffic, either deliberately or of necessity, because of shortage of aircraft and crews. It is a purely Government-subsidized company: foreign aircraft, foreign personnel, but a black-red-gold binder. And understandably the man in the *Handelsblatt*—whether semi-officially or privately—asks: Are we to buy further trouble for ourselves with our money, when we can have it easier?

Bonn circles place great hopes in the energetic German Atomic Affairs Minister, Franz Josef Strauss (right), who as Vice-Chairman of the Federal Defence Council also has to deal with coordinating the defence programme. Left, Federal President Theodor Heuss.

An indication that German air transport could also be run as a private enterprise is provided by the following case. There has for years been a travel agency in the Rhineland known as Tigges, which organizes low-cost bus and train travel to foreign countries. Recently Tigges amalgamated with the Düsseldorf transport operator Karl Herfurthner to include air travel in its programme. Herfurthner already owns three Vickers *Vikings* stationed at Düsseldorf and flown by Anglo-German crews, and plans to purchase three to five *Viscounts*. Business is good, and all air trips to the Mediterranean are sold out. And—irony of fate—the *Lufthansa* is said to be negotiating with Herfurthner to charter aircraft from him for its domestic German services. Meanwhile Herfurthner has not been idle. His is the first German air transport undertaking to have applied for authorization to fly to Berlin. Whether he receives it or not, more will be heard of him, and should he succeed he will have shown the Federal Transport Minister that it is possible to run air services without subsidy even in Germany.

To sum up, the attitude of the Federal Transport Ministry's Aviation Department may perhaps be regarded by air transport bosses as extremely farsighted. From the European point of view, however, it is selfish and nationalistic. Here is no trace of European integration!

Officers and N.C.O.'s for the future German Air Force: at the beginning of 1956 the first volunteers for the new German air forces moved into Nörvenich training centre, near Cologne.

Where deficiencies lie

On December 14th, 1955, the German weekly magazine *Der Spiegel*—which of late has occasionally agreed with the Federal Chancellor's policies and seems to "hear the grass growing" in Bonn—published an inquiry into "where the deficiencies lie," namely the deficiencies in the Federal Defence Ministry. According to this source, the Federal Chancellor had worked out with his Cabinet plans for reorganizing the Defence Ministry, including a new post for Defence Minister Theodor Blank. In any case it is strongly rumoured in Bonn and elsewhere that all is far from well with the Federal Defence Ministry, that Theodor Blank is not playing an exactly happy role, that the Americans, too, are anything but pleased with progress on German rearmament to date.

Where does the trouble lie?

A brief anecdote published towards the end of the year in the Zurich paper *Die Tat* illustrates one side of the problem. Among the German prisoners recently returned from Russia was a lieutenant general who had been at Stalingrad. Immediately after his release he ran into an old acquaintance, a German major.

The general asked after various leading officers. What, for example, had happened to Admiral Dönitz? He was in Spandau, was the answer. "Spandau? What is an Admiral doing in Spandau, near Berlin?" He was then told that Dönitz was "of course" in prison at Spandau as a war criminal.

"What is former General Speidel doing?"—"Oh, he is in Paris." — "Also in prison?" — "No, with N.A.T.O., of course."

"And what about General Heusinger?" — "He's in Bonn." — "In prison, of course?" — "No, at the Defence Ministry."

The general left his friend rather suddenly, saying: If all that is regarded as a matter of course, then he should of course be in an insane asylum, because he understood none of it . . .

There are probably a good many others who find themselves in the same position as this German general invented by the Swiss paper. They no longer understand what is going on

Federal Defence Minister Theodor Blank *(right)* hands the first generals of the German armed services, Lieutenant Generals Heusinger and Speidel, their commissions.

Swearing in the first 101 officers and men of the German *Bundeswehr*.

They have seen one man thrown out because of his "Nazi past" and another, of a practically similar brand, raised to high office. This lack of direction, this confusion in the personnel policy has probably infected the whole top organization of the Defence Ministry.

In an attempt to see more clearly in these questions and to discover why progress towards German rearmament has hitherto been so slow, the Editors asked a Bonn observer for a brief report.

"... Even if the first uniformed military band marches with trumpets blowing through the streets in February 1956 as part of a recruiting drive for the armed services, the *Defence Ministry* and hence the *Bundeswehr* does not appear in a very attractive light.

"The Ministry's personnel policy remains confused, even incomprehensible. True, it has its own personnel section to select senior staff. But there is also another 'Personnel Screening Committee' appointed by Parliament, whose task it is to check candidates' democratic reliability. So far the Ministry's personnel section has taken no action to reorganize staff on the proposals or recommendations of the Government board. This has given rise to the strange situation in which a number of men who have held leading positions for several years have been turned down by the Parliamentary committee as being unsuitable for military service, but have been permitted by the Defence Ministry to continue in their present posts as civilians. Such a situation must, however, handicap the Ministry's whole work, and a trial of strength between Parliament and the administration seems imminent.

"Despite the internal tensions at the top of the new *Bundeswehr*, the first call-up of 2,000 volunteer officers and N.C.O.'s was finally completed early in January. They are to be trained under the initial 6,000-volunteer programme, as instructors for the cadres to be set up later. These cadres consist of four Army training companies at Andernach on the Rhine, one Air Force training company at Nörvenich, near Cologne, and one Navy training company at Wilhelmshaven, the old German war base. This is the beginning.

"What else is going on? Some 50 officers of all arms were sent to the United States at the end of the year for training in new weapons. About 40 former *Luftwaffe* pilots arrived at the American base of Fürstenfeldbruck, near Munich, for refresher courses. At the end of February the first 6,000 volunteers should be in service. And in April 18,000 men of the present Frontier Defence Corps are to be taken over into the Bundeswehr. Thus, if all goes well, by October 1956 there should be some 24,000 officers and men under arms in all three services combined.

German rearmament has got off to a slow start. The only fully efficient performance is being put up by the *Bundeswehr's* first uniformed military band, which is to march through the streets in February.

"As regards armament, the first American weapons are expected to be handed over at the end of January or beginning of February, though at the time of writing nobody seems to know what or how much will be received.

"But in what fields and to what extent the German economy could cooperate in the process of rearmament... appears to be entirely uncertain. The impression is growing that no clear programme exists. The publication *Wehrtechnische Hefte*, which enjoys a high reputation even in Bonn, put its finger on the weak spot when it wrote in December 1955:

'Milliards of Marks are today available for German armament purposes... The Blank Office (today's Defence Ministry) has spent several years preparing to spend these funds as usefully and efficiently as possible. Nevertheless the most essential prerequisites are apparently lacking; namely that the Defence Ministry should state clearly and in detail what it needs in the way of weapons, ammunition and military equipment of all kinds.

'No industry and no economy in the world can undertake deliveries until these technical requirements are laid down and suitable types selected. The German industry has not been slow in making proposals. Other countries, too, have long been falling over each other to demonstrate and offer weapons and equipment to the Germans.

'We consider the reasons for the failure to lie in an inefficient organization, in which a very small number of military experts on arms at an out-station (Koblenz) are vainly seeking, far from the departments responsible for decisions, to prepare the most urgent problems of technical requirements for decision, with quite inadequate material and personnel... Because these prerequisites are lacking, decisions have been postponed from year to year. The aid most urgently needed is a real research, develop-

A freshly uniformed squad of the German Army's instructional units stationed at Andernach on the Rhine being led into dinner: pea soup with bacon, followed by stewed apples.

The bulk of the Frontier Defence Corps (picture) is to be incorporated in the *Bundeswehr's* cadre units.

ment and test organization, staffed by top-rank experts and amply provided with modern test equipment."

Here is the answer to the question of where the trouble lies. It obviously lies in a defective organization and in the staffing of key posts. The criticisms made here come exclusively from German sources, indeed from expert German sources. Unless this organization is improved, there can be no talk of integration in the military domain, at any rate not as far as Germany is concerned.

German industry — absent

The extract just quoted from the *Wehrtechnische Hefte* also provides the first answer to the question of why the German aircraft industry has hitherto made no progress. But *Interavia's* editors are thorough people and have asked for the views of a German industrialist who was well known years ago but has been clever enough to remain in the background of late. Professor Karl Thalau at one time played a leading role at the Deutsche Versuchsanstalt für Luftfahrt (German Aeronautical Research Establishment), went to Argentina after the war so as to keep in touch with practical developments and returned not long ago to Germany, where he was welcomed with open arms. Today he belongs to the management of Messerschmitt A.G., of Munich and Augsburg, a firm hoping for reactivation.

"... Whether personal resentment dating from the war years, technical uncertainty among those responsible for the starting signal or the present absence of a financial basis are the reasons for the delays in getting the new German aircraft industry under way, one need not be a clairvoyant to predict that it will make a fresh start in the year that now lies before us.

"This fresh start will probably open with the prepared initial programme for building a number of foreign aircraft types under licence, leaving aside the new Dornier Do 27 which has been designed in Spain. Probably this still modest industry will receive additional stimulus through repairs and supplying spares for the combat aircraft made available by other countries. Thus it should be possible gradually to train a fresh nucleus of skilled workers, fitters, inspectors and works engineers.

"Under these plans the German aircraft industry will not be able to regain the place it once held by virtue of its technical achievements—not to be confused with the size it attained because of wartime requirements. With its existing resources and those still under heated discussion it cannot even catch up with today's technical development, let alone become a rival to the leading airfaring nations.

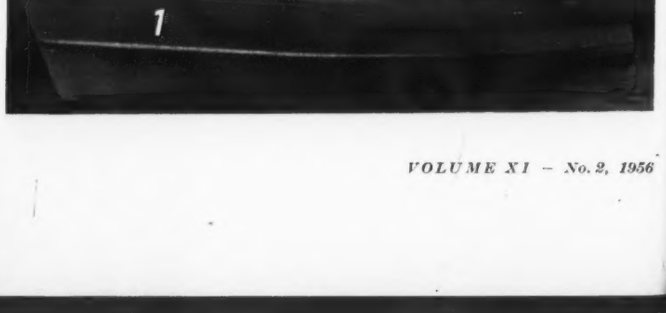
"The United States aircraft industry—the second largest industry in the country after the automobile industry—today employs some 900,000 persons, and the British aircraft industry around 350,000. These figures are in proportion to their countries' populations. The West German Federal Republic will have to be content with a very much smaller percentage. But simply to turn down an aircraft industry for the Federal Republic would be as ridiculous as saying there should be no blast furnaces, no power stations or—in future—no atomic energy.

"The only question for discussion is therefore to what extent Germany should aim at participating in technical progress in aviation. The answer can only be: to the extent of its human, material and financial resources; i. e., in a measure varying and—we hope—increasing in time. The few firms of note who have kept small technical development staffs occupied during the past decade and which have now banded together into four working groups today can call upon an engineer potential that could perhaps develop *one* modern aircraft type up to the production stage.

"In view of the tremendous sums that have had to be spent in countries which were not obliged to break off their development in 1945, the question may arise of whether Germany,

Armoured car belonging to the West German Federal Frontier Defence Corps' signals units.

Modest beginnings for a new German Navy: in mid-December 1955 a new coasta patrol boat for the Frontier Defence Corps left the Friedrich-Werft at Bremerhaven. Amidships the aerial for a panoramic radar equipment.



which is only at the beginning of its economic recovery, can take its place in this modern aeronautical development. One thing is clear: nowhere in the world can modern aircraft types be developed without Government aid. No private enterprise is strong enough to carry the technical and economic risk on its own shoulders.

"Cooperation with leading manufacturers in other countries may later lead to another phase in German aircraft manufacture: a technical distribution of labour on a major international scale, on a basis of 'fair shares'."

Can there be any clearer acceptance of the notion of integration?

If the rebirth of the German aircraft industry were to come about at all, as Professor Karl Thalau has optimistically forecast for 1956, this would be possible only because it has been possible since 1950 to revive the old research institutes on a modest basis. Credit for this feat belongs to a group of German aviation scientists, notably to the energetic sponsor of German research, Secretary of State Professor Leo Brandt. In opposition to a number of failures we mention his name because he has also succeeded in establishing close ties with aviation in foreign countries and in restoring some of the confidence Germany had lost.

The Aerodynamics Research Institute at Goettingen, the German Aeronautical Research Institute at Brunswick, the German Aeronautical Test Centre at Mülheim-Ruhr, the German Glider Research Institute at Munich-Riem, the German Helicopter Study Group at Stuttgart, the Institute of Jet Propulsion Physics at Stuttgart have been resurrected or built up from scratch.

Tasks still to be performed are:

To establish an annual, much enlarged research budget and to appropriate the necessary funds; to bring back the German specialists now scattered all over the world—or at least those who want to return; to prepare the training of the next generation of engineers and scientists, to encourage study abroad and study trips to other countries, and this also for the important purpose of strengthening relations with foreign countries. With the help of the German scientists—who in most cases are much more far-sighted than many a pen-pusher and civil servant—it may be possible to achieve an integration which today is still a mere topic of conversation.

The integration of the rest of Europe

This detailed discussion of the German aspect of the problem is not due to a predilection for criticism. It is due to the fact that at the turn of the year Germany, i. e., the West German Federal Republic, had become a testing stone

A number of officers of the new German forces has been sent to the United States for retraining. Here officers of the signals units arrive at the U.S. Army's training base at Fort Monmouth, New York.

for Europe's development as a whole. In 1955 West Germany regained her sovereignty, and under the Paris Treaties she assumed obligations from which she cannot withdraw. What was the anonymous writer's expression in the *Handelsblatt?* "After consultation one should agree on a line backed by all—whatever such a line may turn out to be . . ." Germany has taken up her position, also vis-à-vis Europe. The West German Federal Republic, now in full economic prosperity as a result of the help it has obtained from abroad, can build up again. It can become one of the main pillars of this European integration. But it will have to choose the line it will back.

For most other European countries the idea of integration is connected with much greater difficulties. The sacrifices they will be asked to make will be not only financial but also idealistic. They will have to surrender certain sovereign rights for whose defence they had gone into World War II.

The way it looks in Northern Europe in this respect was described by the Helsinki Correspondent of the *Neue Zürcher Zeitung* on January 2nd:

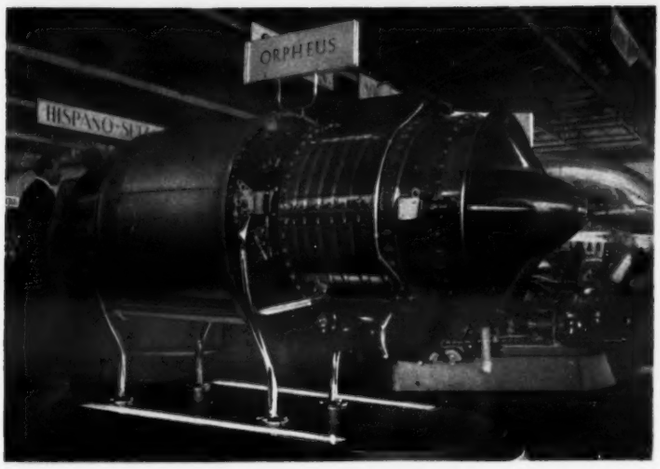
While the Norwegian defence appropriations for 1955 had been cut from the original minimum estimate of Kr. 330,000,000 to Kr. 280,000,000, a further 25-percent cut must be anticipated for economic reasons for the next fiscal year. In order to soften the psychological effect such a measure might have on the other N.A.T.O. countries, Norway's Prime Minister Gerhardsen declared in his New Year Message that "it would be a disaster if the solidarity—i. e., the integration—of the Western nations were to dissolve."

But at the same time the Correspondent reports the formation of a new Norwegian political party, the most important plank in whose platform is the cry "Away from the Atlantic Pact."

He also voices American fears that a possible neutralization of Norway and Denmark—Sweden is not a member of N.A.T.O.—would expose the whole Northern flank of Western Europe. The Southern flank is already in danger, owing to the tensions in the Near East. In addition, one should not overlook the attitude of Sweden's Foreign Minister Unden, who has advocated a "neutralization of Germany."

What about Belgium and Holland? It is no secret that both countries are relatively weak in the air. First deliveries of the Hawker *Hunter* fighter—licence production of which started years ago—are now taking place, but by the time sufficient numbers of the type are ready

Training German personnel on radio equipment and teleprinters at Fort Monmouth.



First steps towards integration of European air armaments: Italy has chosen for the Fiat G. 91 ground attack aircraft (right), now under development, the same British Bristol *Orpheus* turbojet (4,850 lbs. thrust) as is fitted in the British Folland *Gnat Mk. 1* ground attack aircraft.

for combat the aircraft will probably be obsolescent.

France? After the fighting in Indo-China, France is now heavily committed, militarily, in North Africa. Though she is the seat of S.H.A.P.E. and N.A.T.O., owing to her obligations on the North African Coast she is hardly a very solid pillar of the North Atlantic Treaty Organization. A sentence from the New Year's letter from one of our friends is worth quoting: ". . . From a national point of view the year has started for us under very curious auspices, if you consider the deep scars which the elections have left on the body of the nation. On verra! . . ." Thus, France is hardly capable of "integrating" at the moment.

And while Britain is a powerful pillar of N.A.T.O. she is not a Continental European one. Historically and economically she has always felt "insularly", and quite logically she has retained her own, undivided command in the new North Atlantic air raid warning organization. So far as Britain is concerned, the call for integration should not be exaggerated.

Really European in their thinking are the Italians. For economic and political reasons they have placed the entire reconstruction of their aircraft industry under the motto "Integration," and apart from few exceptions, they have purposely neglected the design and development of their own, national types of aircraft. After the war they started with the manufacture under licence of British fighters and engines. They pursued the same policy when they switched over to the production of American aircraft and power plants. Quite recently they furnished a further proof of their desire for cooperation and chose the Bristol *Orpheus* gas turbine as the power plant for their latest creation, the Fiat G.91 light fighter. But of what use is all the praise in the world if one considers that a roof cannot rest on a single pillar—many pillars are needed.

On the threshold of 1956 Europe must find the line which she will have to back.

N.A.T.O.'s Commander-in-Chief, General Gruenther, wants to build up an integrated Western European air defence warning system, which is discussed elsewhere in this issue.

The President of the U.S.A. asks the U.S. Congress for new, increased funds in order to encourage the European nations to build up their joint defences in the interest of "Mutual Security."

Compare these measures with the titles of the main feature articles of *U.S. News and World Report*—often regarded as Washington's mouth piece—in the past few weeks:

— "We are only five miles from Russia," by Lieut. Gen. Joseph H. Atkinson, Commander in Chief, Alaskan Command.

— "We must avoid the first blow," by Gen. Curtis E. LeMay, Chief of U.S. Strategic Air Command.

— "If you wait to be hit, you may never hit back," a report on the recent Army-Air Force manoeuvres, "Exercise Sage Brush."

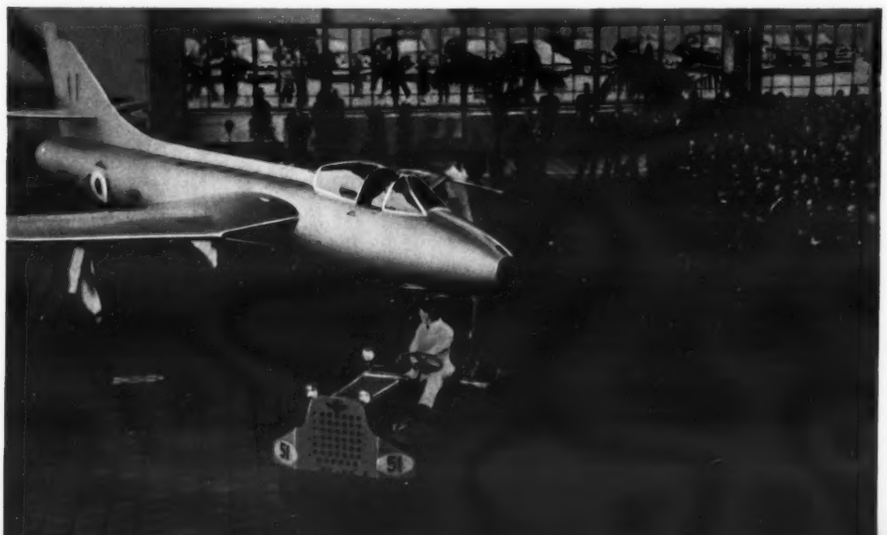
These headings are not chosen out of sheer sensationalism, but simply to demonstrate the fundamental changes that have occurred since the "Summit Conference" of the Big Four last July.

In North America, integration is an accomplished fact: militarily, and especially in aviation, the U.S.A. and Canada form a single whole.

Europe? Today the Germans have a chance they have never had before. The question is whether they have the greatness necessary to make use of it.

W. E.

Licence production of the British Hawker *Hunter* jet fighter in Belgium and Holland, under way for some years, is making slow progress: the first *Hunter* built under licence by Fokker is being handed over to the Royal Netherlands Air Force.



A Provisional N.A.T.O. Plan for Western Europe's Air Defence

BY INTERAVIA STUDY GROUP

During its December 1955 meeting the Atlantic Council approved a system of *coordination* for the air defences of the countries of Western Europe that are members of the North Atlantic Treaty Organization. Two months earlier General Gruenther, Supreme Allied Commander Europe, had reported that air defence was the weak spot in the Allied system, adding that the main reason for the inadequacy of this vital warning and interception instrument was its "archaic" command system.

It was thus not the mediocre performance of the fighters now in service, nor the absence of anti-aircraft defence missiles, nor yet the gaps in the radar warning chain that mainly disturbed the Supreme Commander, but the "archaic" air defence command system. General Gruenther was doubtless comparing the relative efficiency of the air defence systems on either side of the Iron Curtain. In this field more than in certain others, totalitarian and monolithic concepts have marked advantages over an alliance of free nations who may agree to place their forces side by side but refuse to integrate them. A brief study of the map reveals the territorial divisions of the European continent, which has become the military and political stake in the struggle between the two *blocs*. On the one side, East Germany, Poland, Czechoslovakia, Hungary, Rumania and Bulgaria, backed by Soviet territory, still form a mosaic of countries, but their common political system has razed military frontiers. On the other side, Norway, Denmark, West Germany, France, Belgium, Holland, Italy, Greece and Turkey show the same kind of territorial divisions, but the political and administrative divisions remain valid in the military sphere. An article in "The Times" of December 16th, 1955, reveals the degree of nationalism still persisting in a field where unity of command and of organization should obviously be the order of the day. The new coordinating powers granted to the Supreme Commander, it added, do not mean that he will be able to move about the air defence units belonging to the various N.A.T.O. members. They represent merely a first step in a process of evolution that must be slow, since national susceptibilities must be considered. The idea of the new agreement is to group the various national resources into regional organizations and then to unite these regional organizations. From the technical point of view, the agreement means that the Supreme Commander can now insist on coordination in such matters as the siting of radar installations. Hitherto each country has installed its radar according to its own national plans, which have not always met the needs of Western defence as a whole.

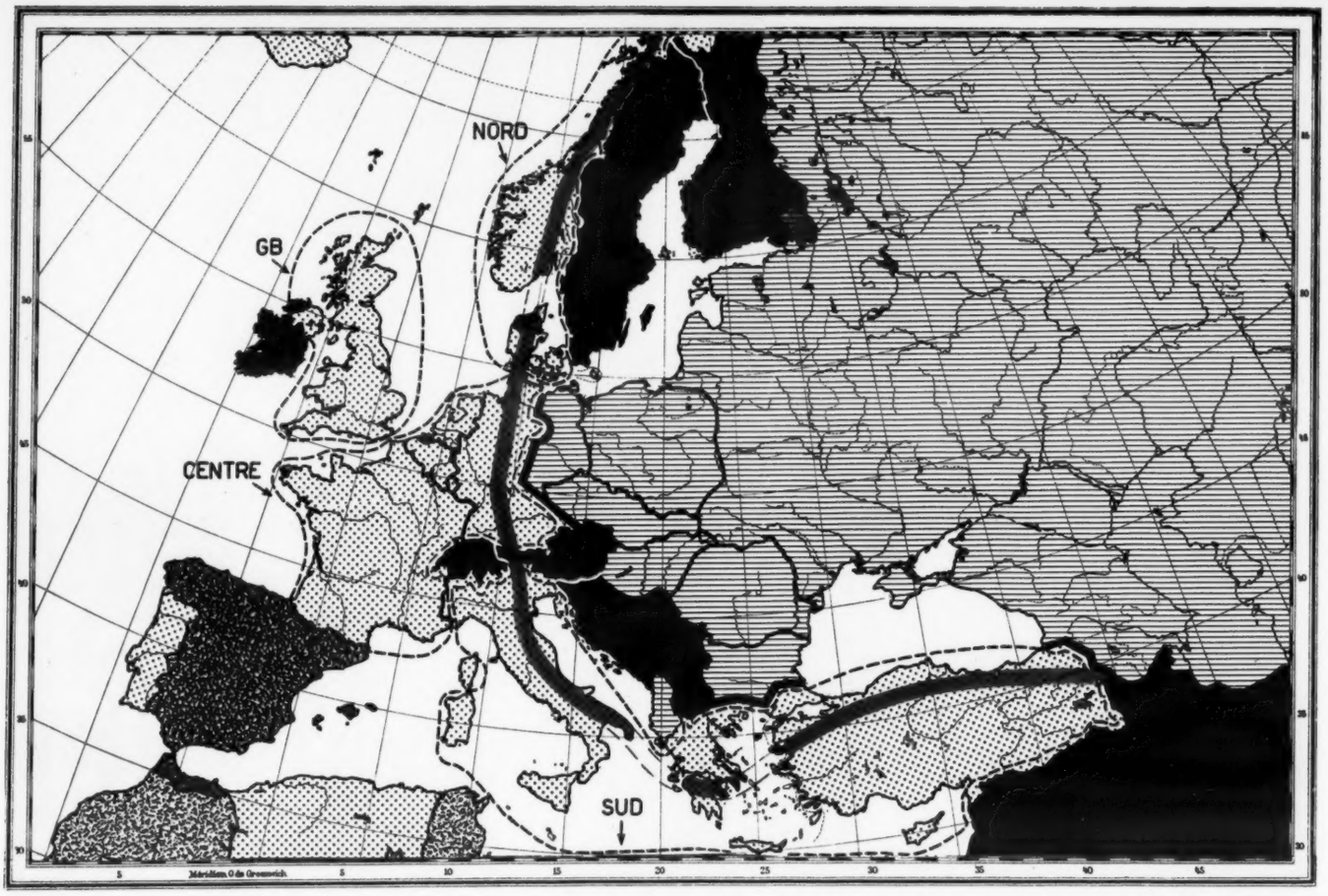
Thus General Gruenther, though responsible for the defence of Western Europe, could not hitherto *coordinate* the deployment or use of the N.A.T.O. countries' air defence system. He still cannot make the best use of the interception units deployed in the theatre which it is his mission to protect, but though still lacking the authority to command, he can now at least *coordinate* or try to do so.

Passing to the other side of the Iron Curtain, is it possible to imagine a similar defensive organization under a supreme command—authorized by the Warsaw agreements—which is not able to move its interception units about in its theatre to meet the most likely threats, or is obliged to respect territorial partitions rendered out of date militarily by the speed of aircraft and missiles and politically by the grouping of countries into supranational *blocs ?*

General A. Gruenther, Supreme Allied Commander Europe (SACEUR), described the command system in Western European air defence as "archaic".

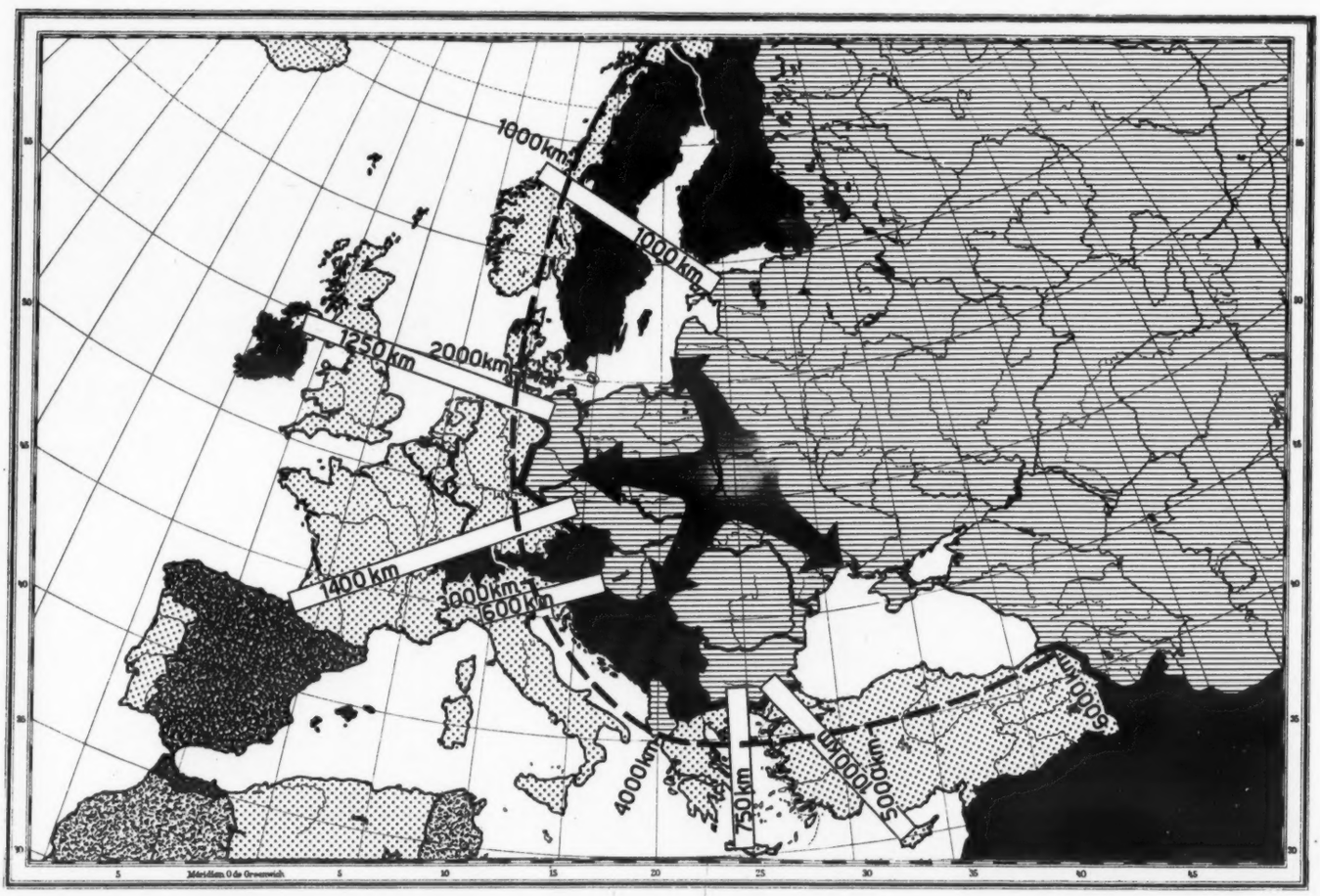
This is why the measures adopted by the Atlantic Council last December must not be allowed to be more than a first step towards the integrated defence system which military experts demand but political experts oppose. Commenting on these measures, the "Daily Telegraph" pointed out that even under the new organization the R.A.F. will decide for itself whether to use its fighters or its anti-aircraft missiles, adding that S.H.A.P.E. had not insisted on assuming command of air defence in Europe. The fact is that national military staffs, arguing by analogy with the recent past—with particular reference to experience of World War II—wish to retain control over their defensive forces so as to be able to use them for the protection of vital targets or areas in their own countries. It is relatively easy to draw up national lists of vital targets and to classify these targets in order of defence priority. It is much more difficult to coordinate these national priority lists into a single inter-Allied list. For example, the inter-Allied command might consider that target No. 12 on country A's list was much more important for the success of its projected operations than target No. 2 on country B's list. At the same time it is natural that country B should wish to give priority to the defence of a target which it considers as absolutely vital. Hence it is difficult to imagine country B giving up part of the interceptor force, which it maintains at great expence, for the defence of a target in country A, even if it admits that the protection of this target may contribute to the success of the Western coalition. There are only two solutions to this problem, both of them inapplicable today: either total integration based on a kind of federalism in defence, or a vast increase in resources which alone would enable respect for purely national interest to be combined with the collective interests of the defence coalition as a whole.

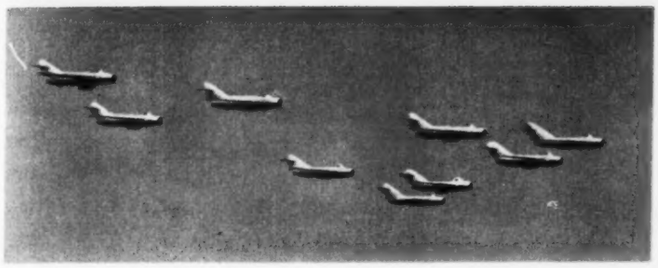
It is for this reason that the Atlantic Council went no further than to accept the principle of "coordination" of defence and was not asked to consider a unified defence control. The results of these decisions (see Map I) are recalled below.



MAP I: The territories on either side of the Iron Curtain can be divided into the following groups: neutral countries (black), Eastern *bloc* (horizontally shaded), N.A.T.O. countries (regular dots), countries allied with N.A.T.O. partners (irregular patches). At the end of 1955 four air defence zones were created for the N.A.T.O. countries: I - North; II - Centre; III - South; IV - United Kingdom. – The shaded band running from the North Cape to the Caucasus shows the region in which Western European early warning radar for the four zones will probably be set up (according to the *New York Herald Tribune* of December 20th, 1955).

MAP II: The West's defence arc stretches 4,000 miles from northern Norway to the eastern frontier of Turkey. Over five-sixths of its length its hinterland is extremely narrow for air defence purposes.





The East's piloted offensive weapons include MIG-17 fighter-bombers for low-level attacks (left) and twin-jet *Badger* long-range bombers for high-level raids (right).

Four air defence regions are set up, as follows:

— A northern sector, comprising Norway and Denmark, with headquarters at Oslo. This sector corresponds to N.A.T.O.'s northern region.

— A centre sector, covering Germany, Belgium, Holland and France, with headquarters at Fontainebleau. Here again the new sector corresponds to the present regional organization of the three armed forces.

— A southern sector, including Italy, Greece, Turkey, the Allied Mediterranean and Cyprus, with headquarters at Naples. A similar military region exists today.

— The British Isles. Commenting on the new organization, the British press emphasized that the defence of the islands is a purely national responsibility and that this responsibility will continue to rest on the R.A.F. However, there will be better *coordination* between the British and neighbouring sectors.

— The Supreme Command will aim at coordinating the air defence plans and the possible use of the defence resources thus organized in four major sectors.

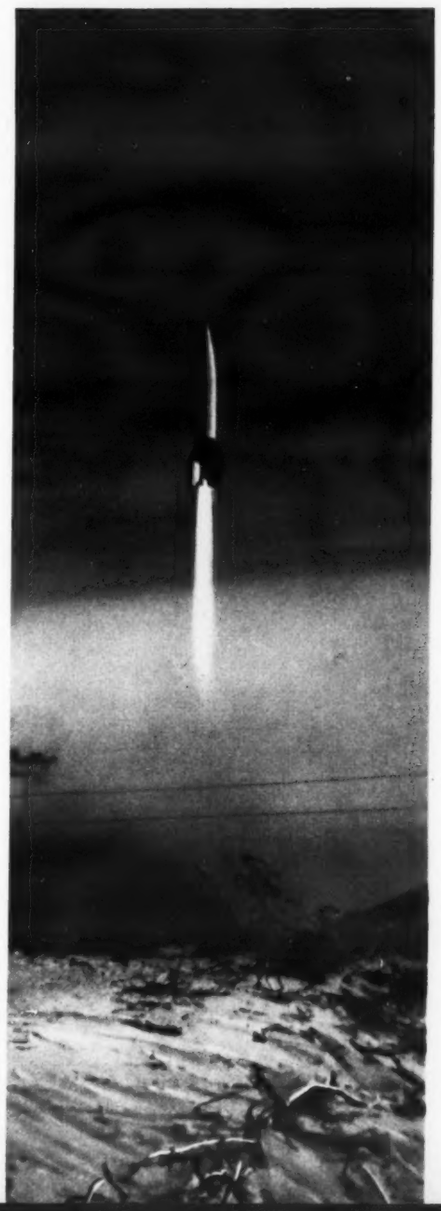
— As his contribution to this rationalization of European defence Uncle Sam will help finance the installation of two new communications systems which, unlike existing systems, will be manned entirely by military personnel.

The special position reserved for the British Isles in the parcelling out of Western Europe's ground and air space will not escape the reader. As it forms a sector on its own, the United Kingdom escapes the dilemma which may in future be created by the necessity for moving national defence forces within a sector comprising several different countries. But though Britain's defence frontier is no longer merely on the Rhine but also in Norway and along the Elbe, the British sector is connected with the northern and centre sectors only through the Supreme Command. The principle of national sovereignty is thus fairly strictly retained, with its advantages and its disadvantages.

Will N.A.T.O. derive real benefit from this new organization of its air defence? In order to answer this question one must first examine the characteristics of the theatre and then inquire what such a theatre is to be defended against.

The geography of Western Europe is hard on the defenders in the age of transonic aircraft and supersonic missiles. In the atomic age the efficacy of defence measures will become increasingly disputable as natural conditions become less favourable.

Among pilotless weapons on the Eastern side are ballistic rockets of the V. 2 category (picture) and remote-controlled aircraft similar to the *Matador*.

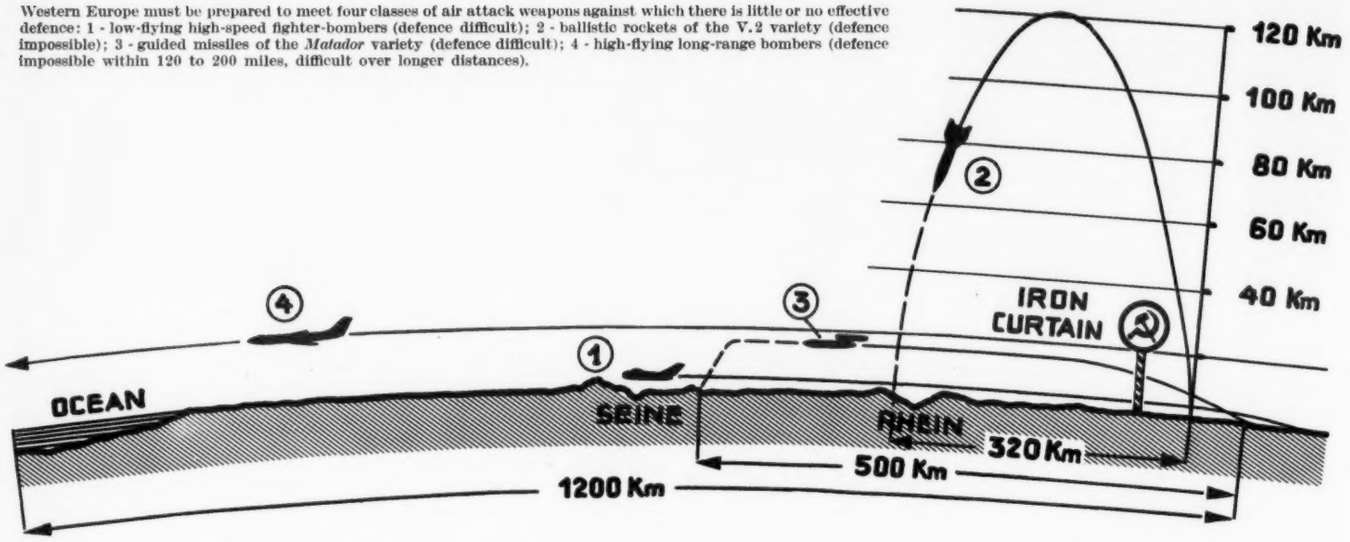


The territory to be defended stretches in an arc of almost regular curvature, measuring nearly 4,000 miles from the North Cape to the eastern end of the Black Sea (see Map II). But this arc covers a relatively narrow region, since its most distant point is less than 1,000 miles from the Iron Curtain. On an average, the distance to be covered by offensive air formations would be from 150 to 1,000 miles. Particularly important regions such as the London area (less than 500 miles), the Rhine basin (215 miles), the industrial region of northern Italy (less than 400 miles) and the population centres of Greece and Turkey (180 miles) are all within an hour's, and in some cases within half an hour's, flying time by a modern bomber.

Over more than five-sixths of the perimeter to be defended, geography or the existence of neutral countries complicates the defenders' task. From the North Cape to the foot of the Danish peninsula, for example, Swedish neutrality on the one hand and the narrowness of Scandinavian territory on the other hamper advance radar warning and restrict the effectiveness of the interceptor force, which has very little space in which to station its units. The same applies to the area between neutral Austria and Turkey in Europe, because of the Austrian and Yugoslav neutrality and the very narrow strip of Greek territory further east. In the case of a purely defensive coalition like N.A.T.O., the neutrality of adjacent areas limits the effectiveness of air defence against a surprise attack. The centre sector, from southern Denmark to the Alps, is the only region in which the two sides are on an equal footing, since they are in direct contact and both have a "rear". For Western Europe, however, this equality is illusory, as its sources of power and wealth (the London and Paris areas, the Ruhr and northern Italy) are much closer to the Iron Curtain than those of the Soviet *bloc*. A glance at Map II shows that the Soviet *bloc* can con

Integration

Western Europe must be prepared to meet four classes of air attack weapons against which there is little or no effective defence: 1 - low-flying high-speed fighter-bombers (defence difficult); 2 - ballistic rockets of the V.2 variety (defence impossible); 3 - guided missiles of the *Matador* variety (defence difficult); 4 - high-flying long-range bombers (defence impossible within 120 to 200 miles, difficult over longer distances).



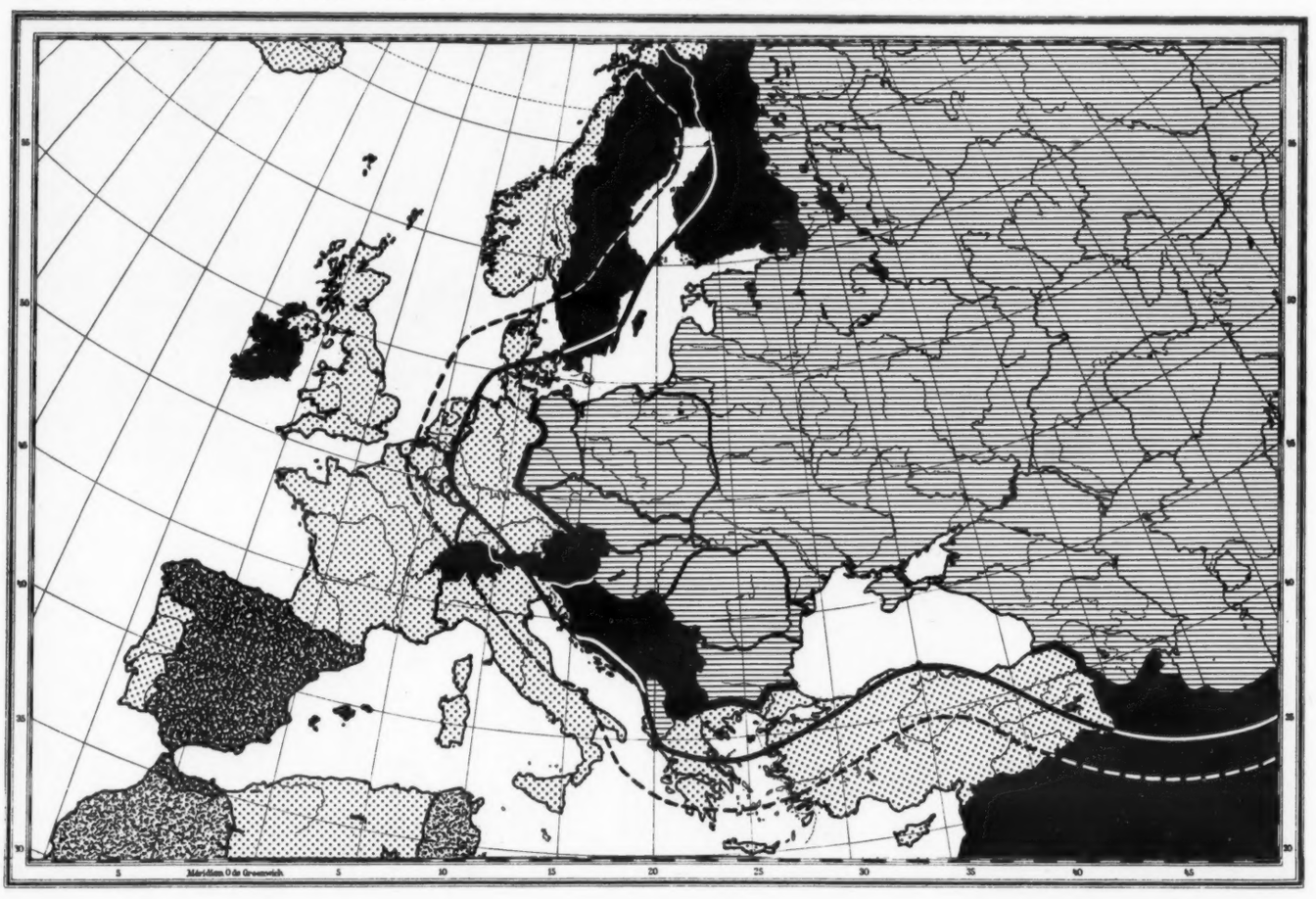
Jet-propelled fighter-bombers of the MiG-15 class can evade the defender's radar warning service by flying low and attain a range of about 400 miles — or more — with auxiliary fuel tanks. A raid of this kind could be detected only by well-trained ground observers (with binoculars), who would have to pass on their observations by telephone or radio to filter stations. The latter would then have to alert the fighter command and the population. In principle, however, today's fighter-bombers can be intercepted by radio-controlled fighters or long-range fighters with conventional armament and by medium anti-aircraft artillery.

Ballistic rockets (V.2 class) cannot be intercepted; the population also cannot be warned. Thus the only form of defence is air or ground attacks on the rocket launching stations (where these are known).

Guided aircraft (Matador class) attacking at medium altitudes can be detected by radar but can be intercepted in bad weather only by rocket-carrying all-weather fighters with radar fire control equipment or anti-aircraft rockets. They can be remote-controlled or steered by gyro; active interference with the guidance system seems promising only in the former case.

Long-range bombers (e. g., Badger) attacking at very high altitudes (50,000 – 65,000 ft.) can be detected only by high-performance radar and engaged by high-altitude anti-aircraft rockets (possibly with atomic warhead) or by rocket-carrying supersonic fighters. The latter would have to be capable of firing on the approaching enemy in a roughly 45-degree climb and thus need mixed propulsion (e. g., rocket motors and turbojets) and an automatic target detection and fire-control radar. Near the "front", however, this type of defence is almost impossible, as a modern transonic jet bomber covers about 50 miles in 5 minutes.

MAP III: The range of Russian robot weapons is roughly 200 miles for ballistic rockets (unbroken line) and 300 miles for guided aircraft (broken line).



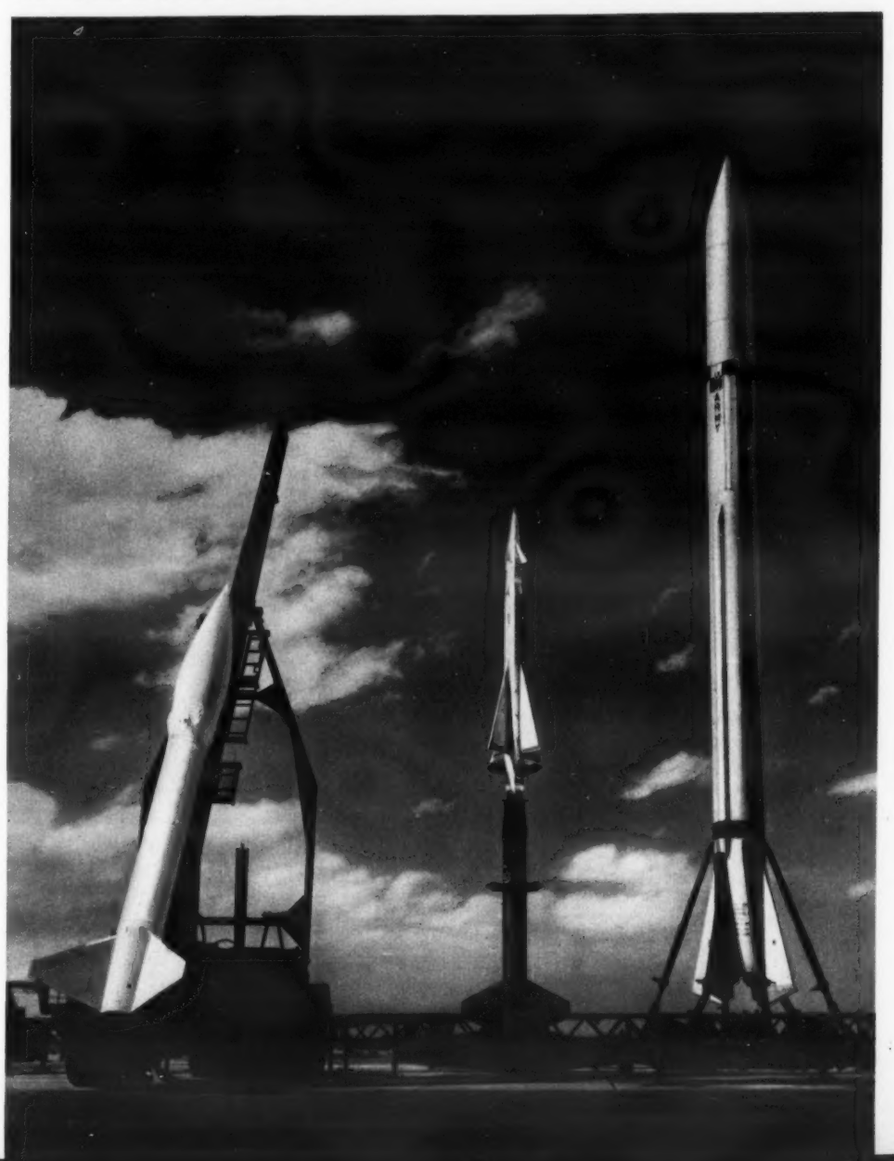
centrate its offensive air forces chiefly in the centre, while the defence to meet this threat must be strung out over almost the whole length of the 4,000 mile arc forming the common military frontier in Europe between the two coalitions.

Any air defence system must today face the threat of bombers flying at more than 600 m.p.h., and tomorrow of bomb delivery vehicles, piloted or guided from the ground, capable of transonic or supersonic speeds. Today, supersonic missiles with atomic warheads can be sufficiently accurately aimed over short distances—i.e., on targets within 300 miles of the launching ramps—to represent weapons of destruction that are all the more formidable since there is no known defence against them. In its guided missiles issue (May 1955) *Interavia* recalled that the Russians have an improved version of the V. 2 whose maximum speed on its ballistic trajectory is believed to be around 3,500 m.p.h. and its range about 200 miles. The range of the Martin TM-61 A/B *Matador* is given as 550 miles and its speed in the region of 620 m.p.h. Assuming that the useful range of such a surface-to-surface missile—i.e., the range within which sufficient accuracy can be obtained—is of the order of 300 miles and that the Russians have offensive equipment equal to the West's, it will be found that a large portion of Western Europe is vulnerable to this category of guided missile flying in the high subsonic range (Map III). Copenhagen, Brussels, Antwerp, northern and eastern France, the eastern half of northern Italy, practically all of Greece and at least half of Turkey would be within reach of missile batteries. However, it should not be as impossible to intercept these weapons as it is for surface-to-surface ballistic missiles which dive upon the earth at high supersonic speed. There is doubtless about the same ratio between the speeds of the *Matador* and a modern piloted fighter as there was ten years ago between the V.1 and the *Tempests* used to intercept it. Nevertheless a *Matador* could cover the distance between its launching ramps and its major targets in less than twenty minutes.

This is where there arises the problem of the small territorial depth of Western Europe, whose population, economic and industrial resources are concentrated in a very narrow strip. It forms the best theatre for the use of the surface-to-surface missiles already in existence or likely to become available within the near future. It is obvious that, if a general war broke out, the belligerents would keep their air forces

The West's air defence will have to be based on a close network of long-range early warning radar stations. Picture shows TH. 221 (Thomson-Houston) aerial group for a French warning station. A large number of trained ground observers will also be needed to detect low-level attacks.

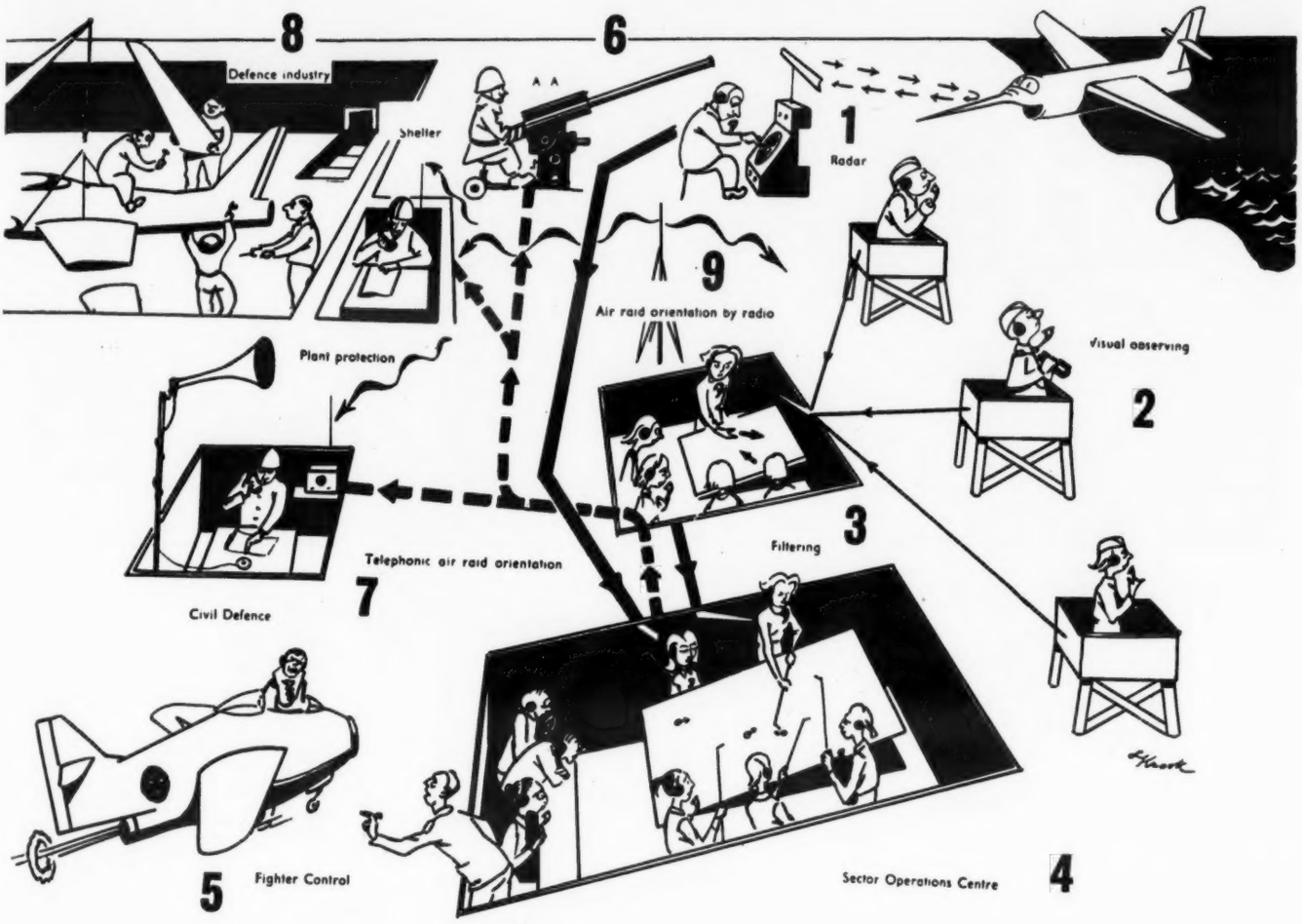
Tactical rockets of the U.S. Army units stationed in Europe: from left to right, Douglas *Honest John* unguided surface-to-surface rocket (range 20 miles); Douglas *Nike* guided anti-aircraft rocket (range 20 to 40 miles); Firestone *Corporal* guided long-range rocket (range 150 miles).



for attacks on targets at medium to long range and that their surface-to-surface missiles would be used for the targets relatively close to the launching ramps. It follows that Western Europe might become the scene of an exchange of guided or non-guided weapons, instead of the victim of attacks by piloted bombers, which would be reserved for longer-range missions. Unless, of course, raids at very low altitudes were found to be effective.

Until the appearance of the Boeing B-52, the engineers had had little success in combining high speed with long range. The first version of the B-36, for example, had illustrated the technical difficulties that had to be overcome. However over the short distances that are all that would need to be covered in order to deal mortal blows to the countries of Western Europe, low-altitude raids by fast aircraft are possible and hence probable. Attacks of this kind could not only be made by high performance aircraft but would also have every chance of being frighteningly effective even if conducted by less modern types flying at high subsonic speeds. The shallow depth of Western Europe constitutes an invitation to use this category of equipment in this way. Thus aircraft flying low to attack close-range targets, accurate subsonic missiles, supersonic ballistic missiles, guided or otherwise, piloted aircraft to attack the rear of the theatre from high altitude, together form a vast range of offensive weapons against which air defence has little to oppose. To draw a parallel between air defence of Western Europe and that of North America or quote expenditure on the other side of the Atlantic in this field in a demand for the same effort on this side is specious. The problems involved are quite different, since the distances separating offensive bases and their possible targets are very different in the two cases. Even then, Walter Lipmann in discussing the lessons of "Exercise Sage Brush" dismisses the idea of air defence. According to the well-known American journalist, the only effective means of defence is the United State's possession of a reprisal force which will be used in the event of an attack on any N.A.T.O. country. In "Exercise Sage Brush" General Weyland placed himself in conditions roughly similar to those that might be expected in Europe. "In the space of 40 minutes, in the opening phase of war games here, attackers using make-believe atomic bombs 'knocked out' half of the entire U.S. striking force in the area and *'destroyed' 80 per*

At present Western Europe's most powerful defence is the threat of atomic reprisals by the U.S. Air Force's Strategic Air Command, which is always at the ready. Three Boeing B-52 *Stratofortress* eight-jet intercontinental bombers ready for delivery to Strategic Air Command.



Sweden's exemplary solution to its air raid warning and air defence problem: early warning radar stations against high-flying attackers (1) and ground observer posts against low-flying aircraft (2) send their reports either direct or via filter centres (3) to the command post (4), which orders the take-off of fighter units (5) and warns the anti-aircraft batteries (6). At the same time local civil defence centres (7) and armament plants (8) are kept informed of the s.tuation, and warnings are transmitted by the broadcasting stations (9). (Courtesy "Saab Sonics".)

cent of its known air bases. During those minutes, the equivalent of 400,000 tons of TNT theoretically was dropped by *light bombers* that penetrated defense zones. This massive blow took less than 30 quick sorties by small, atomic bombers—B-57 jets—but it represented about as much explosive power as was delivered by all 250,000 sorties in threee years of war in Korea."

This brief journalistic account illustrates the new conditions under which the defence must now operate. Not only must it be effective against a very high percentage of the attackers because of the scale of destruction wrought by even a small number of atomic projectiles, but it must reach this efficiency during the first attack, since a second raid might never be necessary. Hitherto the defensive organization has always progressively adapted itself to new forms of offense. But this adaptation has always been very slow. After five years of air war and at the cost of a vast force of personnel and equipment, General Kammhuber's air defence belt succeeded in destroying less than 5% of the bombers which crossed it each day. Such daily losses inflicted on the attacker during a period of months or even years constituted a considerable drain on the Allied resources. However, they would be insignificant if the attacker, using atomic weapons, obtained a decision within a few hours or a few minutes, as in the case of "Exercise Sage Brush".

Must one then give up all idea of air defence, save the money now spent on warning chains and interceptor forces and make no attempt to defend what is regarded as an indefensible air space? A principle as old as the art of war and two technical facts support the opposite view. The principle is that offense and defence take the lead alternately and that, though the offensive may appear to hold all the advantages today, it is by no means certain that the situation will remain so indefinitely. The first of the two technical facts is the development of surface-to-air missiles, use of which is bound up to a certain extent with the ground radar control system employed for the guidance of interceptors. These missiles will increase the efficiency of interception, at any rate at high altitudes. The second factor to be considered is the use of nuclear warheads in anti-aircraft missiles. It has been reported that the United States is already experimenting with atomic *Nikes*. It is doubtless with an eye to such future developments that N.A.T.O. is tackling the problem of air defence in Western Europe, and probably because of the time it will take to reach a given operational efficiency that the North Atlantic countries have accepted a command organization of a provisional nature.

Members of the Seventh Field Artillery (Rocket) Battalion, U.S. Army, during exercises at Grafenwohr, Germany, remove the thermostatically-controlled heating pads from an *Honest John* rocket in preparation for placing the rocket on the launcher.

HONEST JOHN IN GERMANY

The Douglas *Honest John* 762-mm unguided artillery rocket is one of three missiles now being assigned to U.S. Army units in Germany —the others being the Firestone *Corporal* surface-to-surface guided missile and the Douglas *Nike* guided anti-aircraft rocket. *Honest John* is purely a tactical rocket with a range of about twenty miles, capable of carrying conventional or nuclear warheads, and is obviously intended for use in mobile warfare.

Practising launching the 6,000-lb. rocket, the soldiers manoeuvre the *Honest John* – minus fins in this picture – from the carrier to the launching vehicle at left.

The *Honest John* is fired in the Grafenwohr Training Area, U.S. Army Southern Area Command, Germany.

The U.S.A.F.'s New Emergency Production Policy

A new "Industrial Production Readiness Policy which will bring the production planning effort in line with operational concepts", has been announced by Air Force Secretary Donald A. Quarles in a memorandum addressed to U.S.A.F. Chief of Staff General Nathan F. Twining on December 28th, 1955. The policy recognizes the impact that nuclear weapons and long-range delivery vehicles have on planning for industrial support of military forces, thus placing greater emphasis on readiness for this type of war than on the "traditional concept" of a prolonged industrial build-up after war starts.

Recognizing emergency conditions under which industry would be required to accelerate production, two special planning concepts are outlined in the policy. The first is the "*Production Compression Concept*" which is designed to achieve delivery to the Air Force of every possible piece of equipment which would be vital during the early weeks of a *general* war. The second is the "*Production Acceleration Concept*" which is designed to provide for rapidly accelerating production of selected weapons that would be critical in a *local* war.

The document states that for the first time in modern history the U.S.A. is faced with a continuing potential threat of devastating destruction at the outset of general war. If, in an emergency, the U.S.A. is to survive and minimize the devastation to the nation, the traditional concept of a prolonged industrial build-up after attack must be replaced with a "readiness" programme.

The aims of the industrial readiness programme are outlined as follows:

1. To deter war by maintaining a modern Air Force in being that can immediately defend the nation and retaliate in case of attack.

2. To make the U.S.A. capable of rapidly expanding production of appropriate weapons in case of involvement in peripheral conflicts short of a general nuclear war.

3. To improve industry's ability to maintain or rapidly restore production of critical survival and retaliation weapon systems and related support commodities in case of general war involving severe industrial damage.

Since sufficient industrial resources are not available to attain the required readiness for all aircraft, guided missiles and support equipment, three production categories are established: Category A (first priority); Category B (second priority); and Category C (third priority).

Category A will include the most important Air Force weapon systems and supporting systems which must be kept in active production under the "most austere emergency conditions."

Category B will include major weapon systems and supporting systems which have not been designated Category A. Under "extremely austere emergency" conditions, surviving production capacity for this category would be reprogrammed to support production of Category A systems. Category B systems will be kept in production under what is termed "adverse" conditions.

Category C includes all remaining weapon systems and supporting systems for which production planning is desirable. Category C systems may not necessarily be kept in production in case of general war, but capacity for this category could be of great value in supporting production of the A and B categories in a general war involving severe industrial damage.

Selective Planning List. — The Air Staff will prepare a Selective Planning List that breaks down the U.S.A.F.'s "Minimum Wartime Aircraft and Guided Missiles Requirements List" into the three Categories. It will be issued during May and November of each year, to be effective for the following six-month period beginning July 1st and January 1st, respectively.

Dr. Quarles' memorandum now refers to the two planning concepts adopted under the new production policy:

1. *Production Compression Capability.* — This term applies to developing a capability for instant maximum all-out production of strategic and air defence weapon systems during the initial phase of a general war (i. e., the first 60-90 days). This immediate increased production can be achieved on the basis of plans for a maximum work week and by draining the normal inventory of finished components, equipment and sub-assemblies on hand in the assembly plant. Even greater potential output is possible by increasing the inventory of finished items maintained at the assembly plant. In developing production compression plans, the following general conditions are to be assumed:

a. The assembly plant will remain intact.

b. No additional personnel will be available during the all-out production period.

c. No support from Government Furnished Aeronautical Equipment producers, subcontractors or vendors will be available during the period.

d. All except local transportation facilities will be lost.

e. Communications facilities will be limited to high priority messages.

2. *Production Acceleration Capability.* — This term applies to developing capability for rapidly accelerating production of tactical or supporting systems to a predetermined peak rate in the case of limited wars or peacetime expansion. Rapid acceleration can be accomplished by maintaining readily expansible production capacity and increasing the inventory of finished and semi-fabricated materials at prime, associated and subcontractor facilities. This capability must be created in advance of an emergency so that it can go into effect immediately.

To achieve this desired state of readiness will require a long-term Air Force-Industry programme. In implementing the programme, the following general policies and specific procedures will apply:

1. *General Policies to Achieve Readiness:*

a. The Air Force will maintain close relationship with industry and trade associations to make sure that emergency production plans are realistic and feasible. Participation, advice and assistance of industry will be solicited and encouraged.

b. It will develop industrial readiness through the normal conduct of Air Force procurement and production. Future contracts for production of Category A or B systems will contain provisions assigning to the contractor responsibilities for completing readiness measures and preparation of emergency manufacturing plans.

c. It will maintain plans for immediate conversion or expansion of industrial production to meet any emergency.

d. It will programme special projects, including necessary funds, to attain maximum production readiness of selected Category A and B systems.

e. Emergency production plans will normally include only systems and equipment of proven design which are being procured for the Air Force inventory. Schedules will be evaluated to make sure that production objectives are feasible.

f. Geographical dispersal of vital defence production and development facilities will be sought to avoid concentration of these facilities within potential target areas. The production sources for Categories A and B systems will be analyzed to determine vulnerability and adequacy of dispersal.

2. *Specific Procedures to Achieve Readiness:*

To assure a readiness capability, the following production base will normally be developed for each of the three priority categories:

Category A:

1. Establish at least two production sources for weapon and support systems, including subcontractor and vendor sources. To the maximum extent possible, establish at least one source away from highly concentrated industrial areas and major military installations.

2. Retain at least one source in production, on a sustaining rate, until production of a follow-on model is sufficient to support critical wartime missions.

3. Develop phased production capacity on an expandable 2-shift, 5-day, 40-hour week basis for primary strategic and air defence systems; and 1-shift, 5-day, 40-hour week basis for other basic systems.

4. Develop plans for emergency production concurrently with current production plans. In developing production plans, emphasize product engineering, tool design, plant layout, subcontracting, manning, facilitation and the ability to convert from current production to emergency schedules as rapidly as possible with minimum disruption of effort.

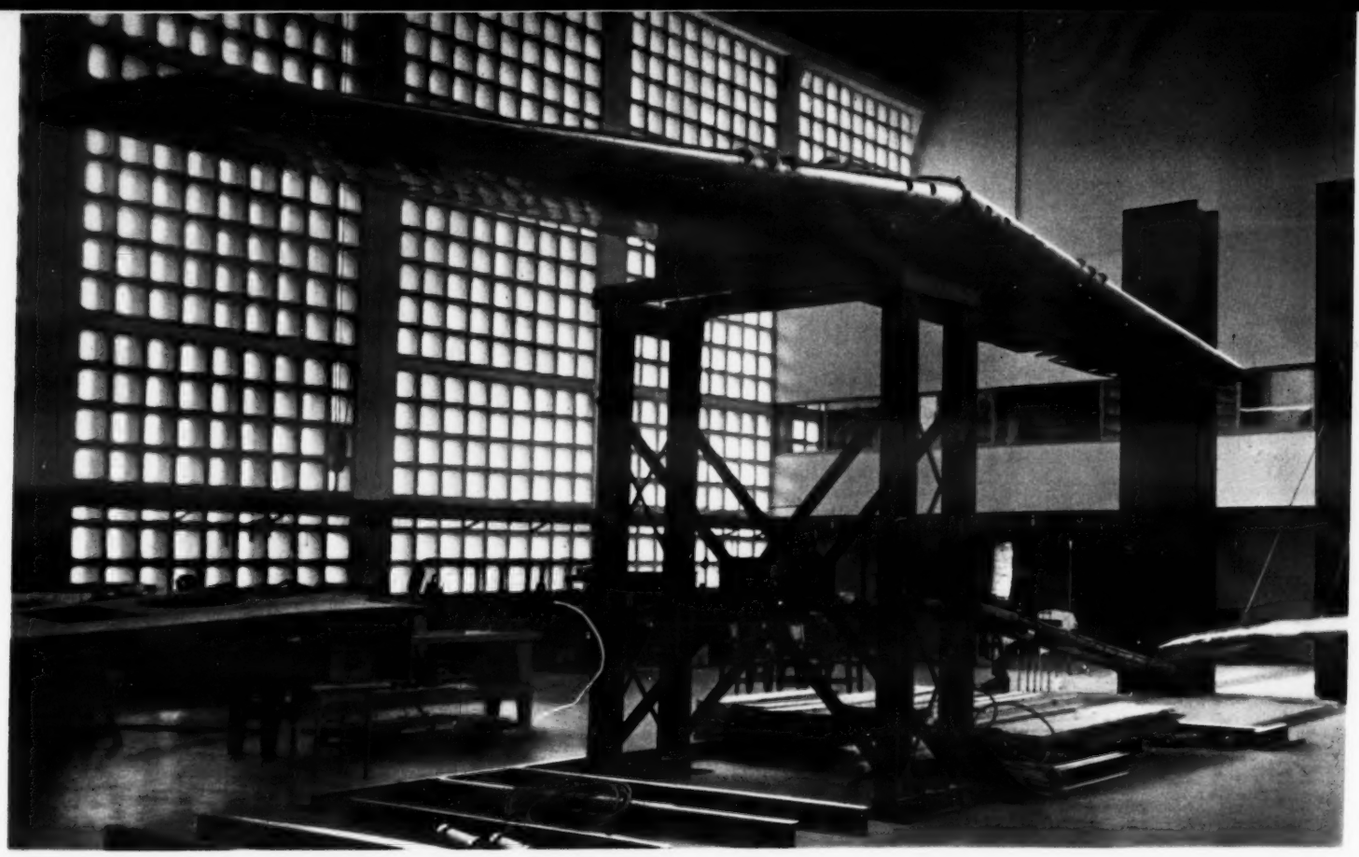
Category B:

The basic conditions established for Category A will be applied to Category B items, except that they will be given second priority in directing available resources and effort.

Category C:

Basic readiness measures will be applied to this category through normal conduct of procurement and production business. Effort, added costs and commitment of resources will be held to a minimum and will be afforded third priority in planning for industrial readiness.

The new policy will take immediate effect, Air Force Secretary Quarles said in his memorandum. All programmes relating to current and emergency production of weapons and supporting systems will be reviewed and adjusted to conform with this policy. The adjustment is to be accomplished as rapidly as possible, but with due regard to economic considerations and the adverse effects of sudden change.



View of the Structures Laboratory at the Centro Tecnico de Aeronautica, São José dos Campos.

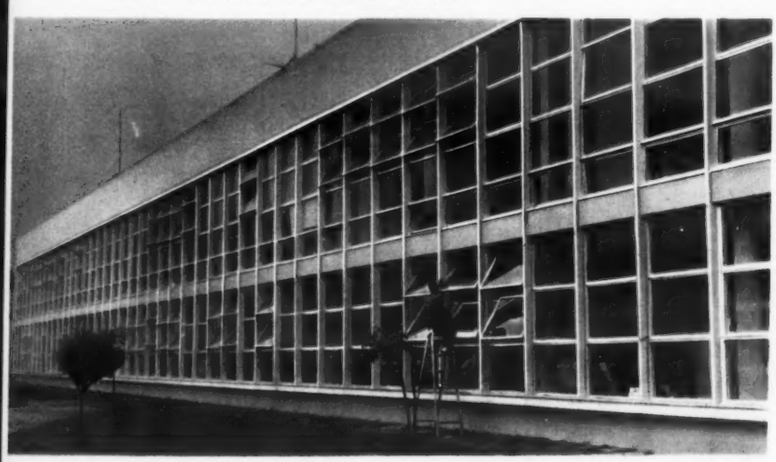
São José dos Campos
Brazil's Centro Tecnico de Aeronautica

BY INTERAVIA'S RIO DE JANEIRO CORRESPONDENT

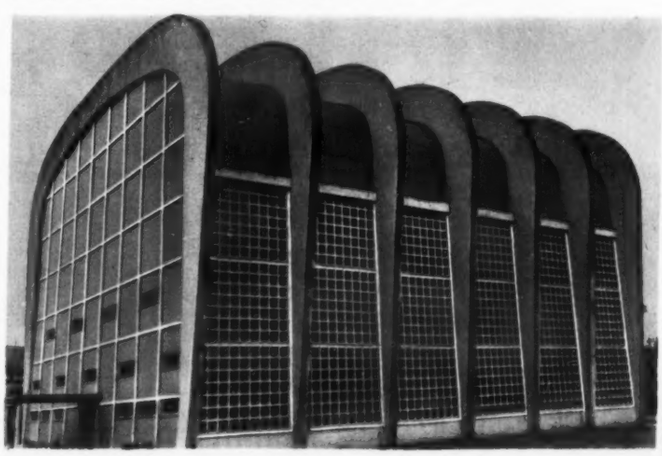
Virtually ignored by the rest of the world, São José dos Campos, a thriving small town of 35,000 inhabitants in the Brazilian State of São Paulo, has developed into one of South America's major aeronautical research centres.

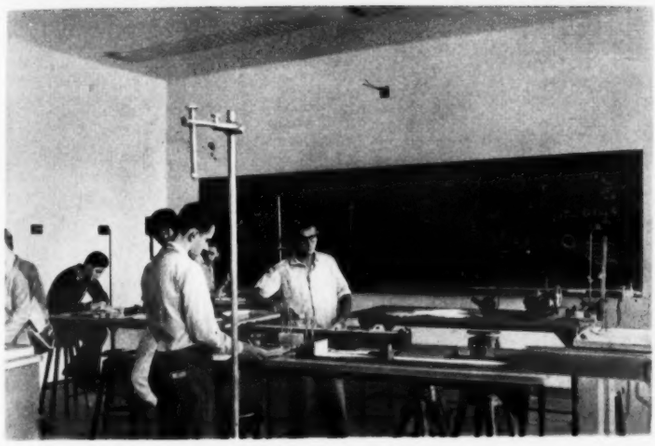
The story began in 1946, when Brazil's Civil Aviation Administration undertook an extensive expansion and renewal programme. At the request of the Brazilian Air Minister, Professor Richard Smith, head of the Aeronautics Division of the Massachusetts Institute of Technology worked out plans for the construction of an aeronautical research and instruction institute. The institute was opened in 1948, provisionally housed in the premises of the Army Technical School, Rio de Janeiro. Known as the *Centro Tecnico de Aeronautica*, it received its first students

Part of the Aeronautical Technical Institute.



The outside of the Structures Laboratory.





A group of students at a practical chemistry class.

Testing a steel spring in the Statics Laboratory.

primarily from among young Air Force officers. Before long, however, it became a technical and research centre independent of the armed forces and of predominantly civilian character. The city of São José dos Campos provided a 3,000 acre site for the new institute, building went on without delay, and today the Centro Tecnico is practically complete and excellently equipped.

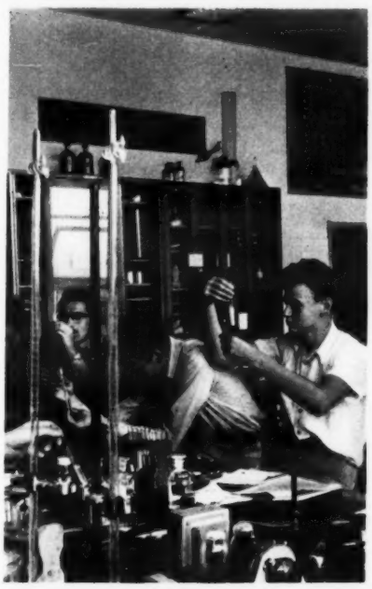
The Centro Tecnico is responsible to the Air Ministry in Rio but has an independent budget granted annually by the Brazilian Congress. The 1956 estimates call for funds totalling 60,000,000 cruzeiros ($ 880,000).

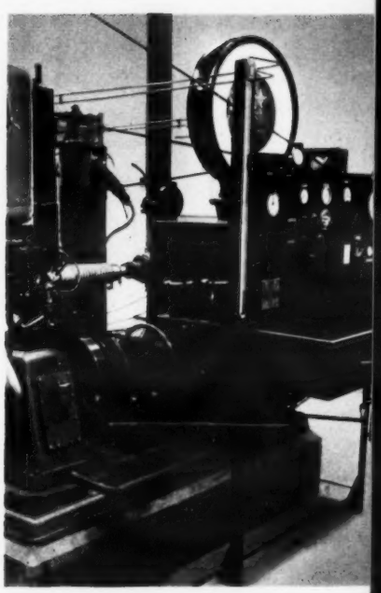
The Centro is divided into two main departments, an Aeronautical Engineering School and a Research and Development Institute.

*

The engineering school (Aeronautical Technical Institute) has three divisions: aeronautics, air transport and electronics. A five-year course is offered, the first two years being devoted to basic schooling in mathematics, physics, chemistry, mechanics, drawing and English. The next three years are given over to the actual professional training. Candidates for admission must have completed their high school education and pass the entrance examinations held every year in 18 major Brazilian cities. The majority of the students naturally come from São Paulo, Rio de Janeiro, Belo Horizonte and Recife.

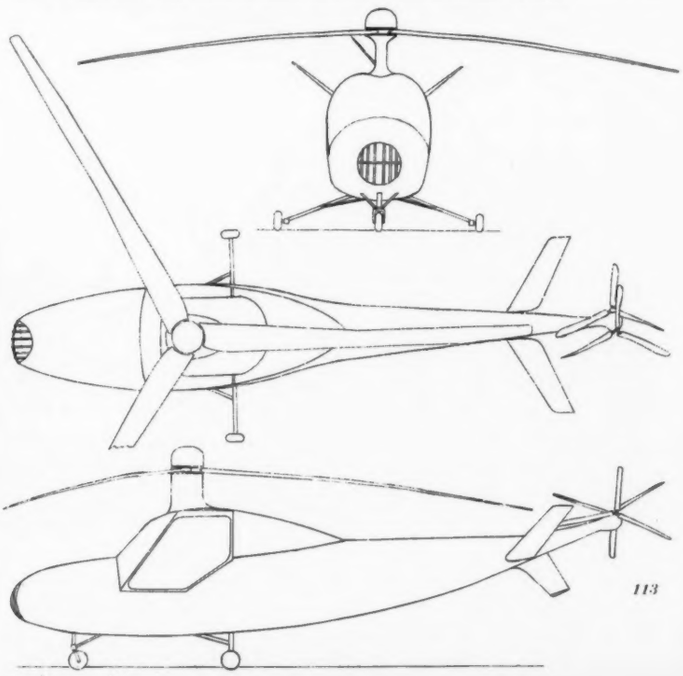
Instruction, board and lodging are free, and each student receives pocket money of 200 cruzeiros ($ 3) a month. There is no racial or religious discrimination. Class, laboratory and workshop attendance are





The chemistry classroom (left) and test equipment for measuring the octane number of fuels (right).

Three-view drawing of the *Focke Beija Flor I* helicopter with Continental E-225-8 engine of 225 h.p. take-off power; rotor diameter 29.5 ft., height 9.2 ft., length 26 ft., gross weight 1,900 lbs., cruising speed 87 m.p.h., max. endurance 1 hour.

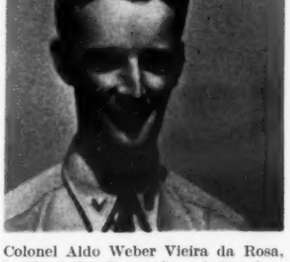


Casmuniz 52 five-seat touring and executive aircraft (with two 225 h.p. Continental engines), an example of modern Brazilian aircraft design.

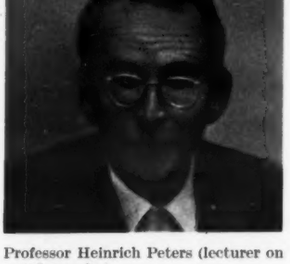
THE LEADERS OF THE CENTRO TECNICO

Brigadier Casemiro Montenegro, Director of the Centro Tecnico de Aeronautica.

Professor André J. Meyer, Rector of the Aeronautical Technical Institute.



Colonel Aldo Weber Vieira da Rosa, head of the Research and Development Institute.

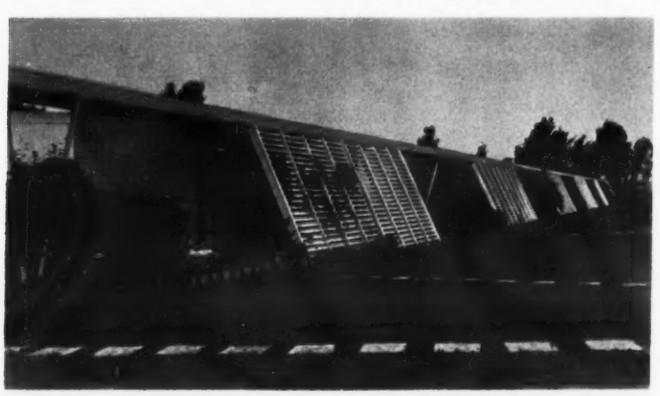


Professor Heinrich Peters (lecturer on aerodynamics).

Professor R. Wallauschek, head of the Electronics Division.

Professor B. E. Young, head of the Air Transport Division.

The faculty residential area, which also includes a sports ground and club house.



A new version of the CAP.4 *Paulistinha* two-seat sports and trainer aircraft (here with 65 h.p. Franklin engine) is to be built.

compulsory. Each year six vacancies are reserved for U.N.E.S.C.O. Foreigners resident in Brazil must apply for places via the Air Ministry and must undertake to apply for naturalization on completing the course or reaching the age of 21. The academic year begins early in March and ends in mid-December. Students may remain on the campus and work in the laboratories during the ten-week summer vacation. The faculty is today composed of nearly one hundred professors, associate and assistant professors, teachers, researchers etc. representing thirteen nationalities. In 1954 there were 240 students and last year 300.

Attached to the Aeronautical Technical Institute is a *Structures Laboratory* which collaborates closely with the Brazilian Patent Office in Rio, *engine test facilities* and an up-to-date *wind tunnel* for subsonic and supersonic measurements, built to an American design.

*

The *Research and Development Institute* has sections for helicopter design, glider design, electronics, structural materials, aviation medicine. The Institute is at present working on a new helicopter and a convertiplane to plans by the German designer Professor Henrich Focke. No details of the *convertiplane* have been released, though the prototype is to be ready for flight testing later this year. The *Beija Flor 1* helicopter (see drawing) has two tail rotors with individual pitch control and a main rotor with folding blades. Flight testing is scheduled for spring 1956 and production is to be handed over to private industry. A single-seat *glider* with folding wings designed by the Institute for the 1956 World Gliding Championships in France is also announced.

*

Professor André J. Meyer, Rector of the Aeronautical Technical Institute, and Colonel Aldo Weber Vieira da Rosa, head of the Research Institute, also believe that Brazil will resume production of the 65 h.p. *Paulistinha* two-seat sports aircraft designed by *Companhia Aeronautica Paulista*. There are still 500 of these aircraft flying in Brazil. Shortage of technical personnel and the absence of suitable research and test equipment forced the company to suspend production. The *Paulistinha* is expected to go back into production this year in slightly modified form. At any rate production rights were recently acquired by *Sociedade Construtora Aeronautica Neiva Ltda.* The engine chosen for the new *Paulistinha* is a 85 h.p. Continental. Power plant and instruments, which will have to be imported during the first production year, are later to be produced in Brazil. Under the agreement between Aeronautica Paulista and Aeronautica Neiva all modifications to the original *Paulistinha* must be submitted to the Centro Tecnico for approval. The Centro is also to be responsible for supervising the manufacture.

Contacts have also been established with the other Brazilian aircraft manufacturers: *Fokker Industria Aeronautica S.A.* (production of Fokker S.11, S.12 and S.14 trainers), *Instituto de Pesquisas Tecnologicas* (IPT 16 single-seat sports aircraft) and *Cassio Muniz S.A.* (*Casmuniz 52* touring aircraft).

Second-Generation Turboprop Airliner

BY BOFFIN, LONDON

It is no exaggeration to say that the Vickers *Vanguard* is the progeny of two strong personalities, those of George R. Edwards and Peter G. Masefield. It is clearly the leadership of these two, manufacturer on the one hand and operator on the other, which has evolved a new regional airliner of distinctive aspect. Cooperation between the two teams behind these personalities has been of the closest—so close that, at times, it had more the appearance of cut-and-thrust!

The *Vanguard's* two "fathers": Peter G. Masefield, until recently Chief Executive of British European Airways (left) and George R. Edwards, Managing Director of Vickers-Armstrongs (Aircraft) Ltd.

For long, B.E.A. held firm to the principle of the high wing, which had proved so popular in the *Elizabethan,* but practical considerations of undercarriage and freight stowage led to its final reluctant abandonment. Yet the mid wing of the V.900 could be taken as a symbol of the practical compromise which is the keynote of the whole design.

Before considering the *Vanguard* in detail—or such detail as a tight trade security clamp will permit—two points anent its background are worth making. In the first place "the old team" of Vickers-Armstrongs and Rolls-Royce came in only after specification discussions on an industry-wide basis—the sentimental incentive was there, but was not allowed to override objectivity in B.E.A.'s selection of its supplier. The second fact is that the *Vanguard* is in no sense a "*Viscount* replacement". It started as such, but it has grown in capacity and it will be offered as the top size in a series of regional airliners—the V.700D, the V.800 and the V.900 offering 40/53, 65/70 and 93/105 seats respectively.

History

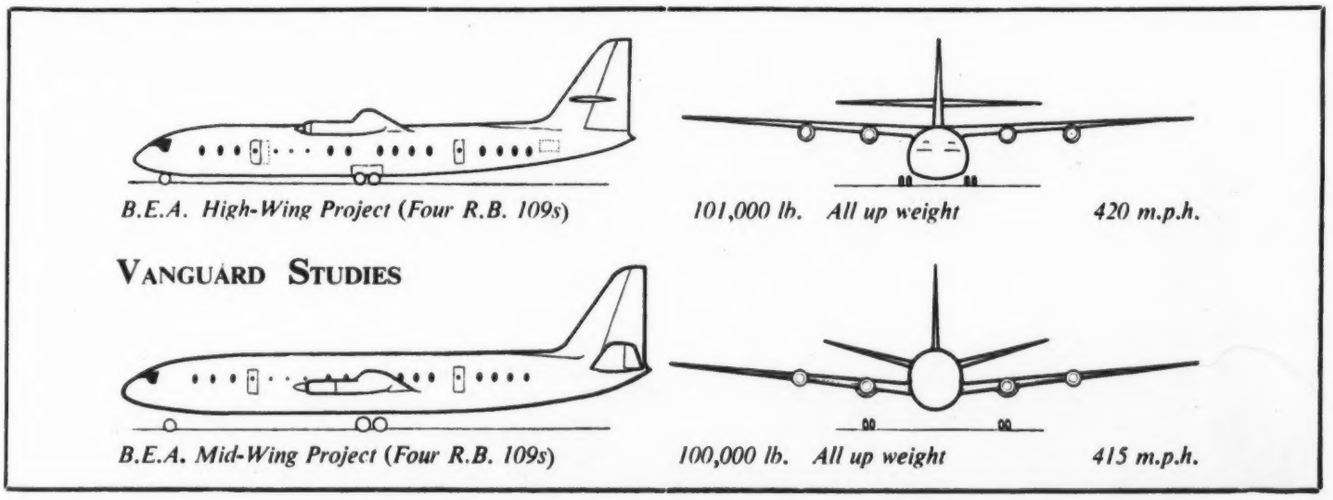
Vickers started with a "stretched *Viscount*" in 1953 (the V. 850) but this was a rather overelongated aeroplane and was abandoned in favour of the forthcoming V.800 variants, which have a very moderate fuselage extension of about three feet. At the same time both Vickers and B.E.A. started serious thinking about a completely new medium-range airliner.

The B.E.A. approach was fundamentally that of finding the formula for a vehicle to suit its route pattern—with the short hauls and highly seasonal loads very much to the fore—and its forecast load factors. First the payload/range characteristics, then passenger/freight amenities, then cruising-speed/airfield requirements—in other words it was the operator's outlook rather than the aeroplane designer's approach. Nevertheless, the B.E.A. Project and Development Branch under R. C. Morgan, and an essential unit in the organization of the Chief Engineer Beverley S. Shenstone, made many detailed studies which embraced complete aeroplane layouts.

The B.E.A. requirements were finalized as a 50-page document, going into exceptional detail, of which the ten salient features were:

1. Between 90 and 100 passengers in three cabins with a superior standard of comfort to any existing today, with four toilets, ample coat-hanging space, two galleys and a bar.
2. Cruising speed of not less than 425 m.p.h. = 685 km/h.

Two B.E.A. studies for its 1960 airliner with four Rolls-Royce RB. 109s, a high-wing layout (top) and a conventional low mid-wing (bottom).


B.E.A. High-Wing Project (Four R.B. 109s)
101,000 lb. All up weight
420 m.p.h.
VANGUARD STUDIES
B.E.A. Mid-Wing Project (Four R.B. 109s)
100,000 lb. All up weight
415 m.p.h.

3. Ability to operate from all B.E.A.'s existing major airports.
4. Cost per seat-mile, at 500-mile sector distance, at least 10 cent per better than the developed *Viscount Major*.
5. Low approach speed.
6. Internal diameter of not less than 130 inches, for 5-abreast tourist seating and 4-abreast first-class seating, with minimum aisle width of 18 inches.
7. Very large freight holds, for stowage of full freight-payload when only a few passengers are carried.
8. Large *Viscount*-type windows.
9. Low noise level.
10. Built-in passenger steps.

This specification was offered to other aeroplane manufacturers, but it was soon the basis for a concerted design effort by Vickers and B.E.A.

In all, sixty detailed studies were made, starting with several using a small by-pass engine, through the original RB.109 at a 2,500 s.h.p. rating. It was not until the end of 1953 that the aeroplane grew from *Viscount*-replacement size to its present large-capacity form. This was influenced, naturally, by the V.800 capacity and the "speed-stretch" made possible by the higher-powered RDa 7 and RDa 8 engines on the way.

The final bone of contention was the wing position. From the passenger viewpoint nothing could have been more desirable than *Viscount* windows with a high wing—every seat an observation car. Practically, however, the large high-wing aeroplane presents an almost insoluble problem for the stowage of landing gear and freight. Head resistance suffers if the log and plank centre section is adopted; if it is not, headroom is interrupted at the spars. Underfloor freight and luggage stowage is impossible. The landing gear is either stalky, or it has a narrow track and must add shock loads to the pressure cabin. Generally, structure weight is up and this, plus the handling inconveniences, is a high price to pay for passenger view and the undoubted safety of the wing's ground clearance.

The high wing died hard and was certainly still in the mind of Peter Masefield in 1954, before the detail work of his Project and Development team finally disproved its feasibility in so large an aeroplane.

The finally chosen layout was kept, at the request of B.E.A., under the closest secrecy until October 18, 1955, when it was released at simultaneous press conferences in London and New York. Despite the fact that this secrecy prevented the "brochuring" of potential customers, Vickers was by no means averse from it until Lockheed had revealed all details of the rival product, the *Electra*.

The Layout

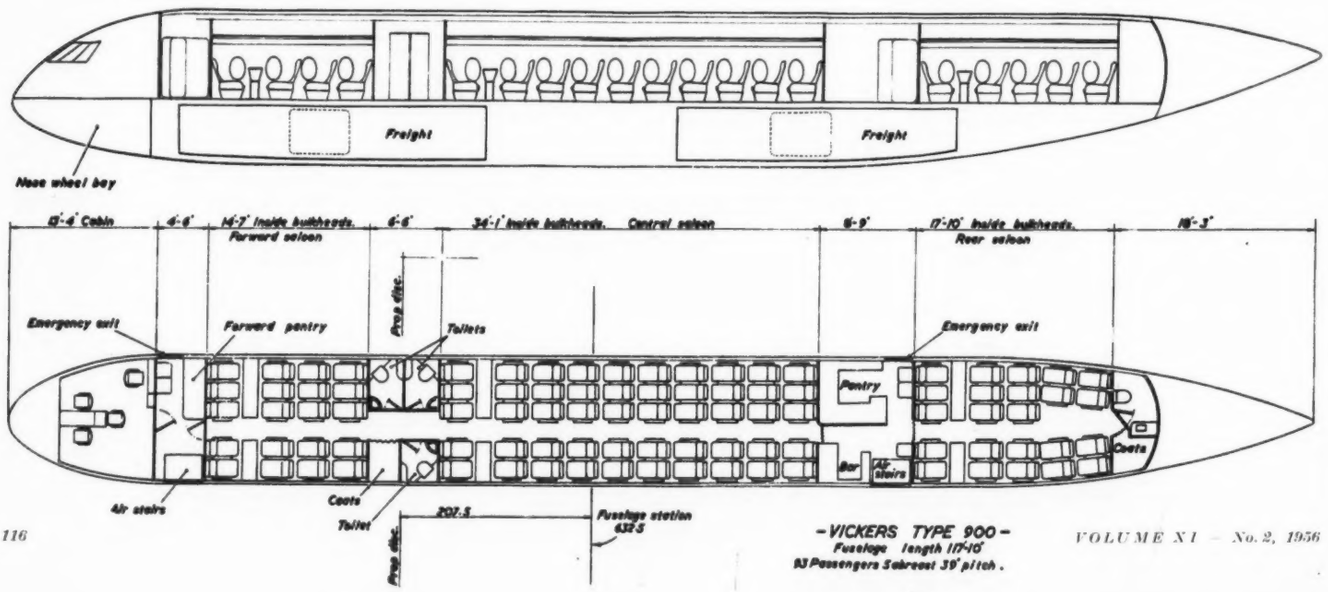
The final choice of a mid-wing is a great deal more than a compromise between the proponents of the high and the low wing. It does, in fact, when combined with the double-bubble hull, go a long way toward getting the best of both worlds.

An important economic factor in the operation of, in particular, turbine airliners is rapid turnround. As the size of the load increases, so more attention must be paid to getting passengers and freight out and in, fuel, food and water in, toilets emptied. The principle is to separate the operations as much as possible. In the *Vanguard*, pressure fuelling and toilet drain points are well spaced, the large freight doors are to starboard, fore and aft of the wing, while front and rear passenger doors are to port. "Air-stairs" for the passengers will save gangway handling time, while the relatively low sit of the spacious holds will allow easy loading.

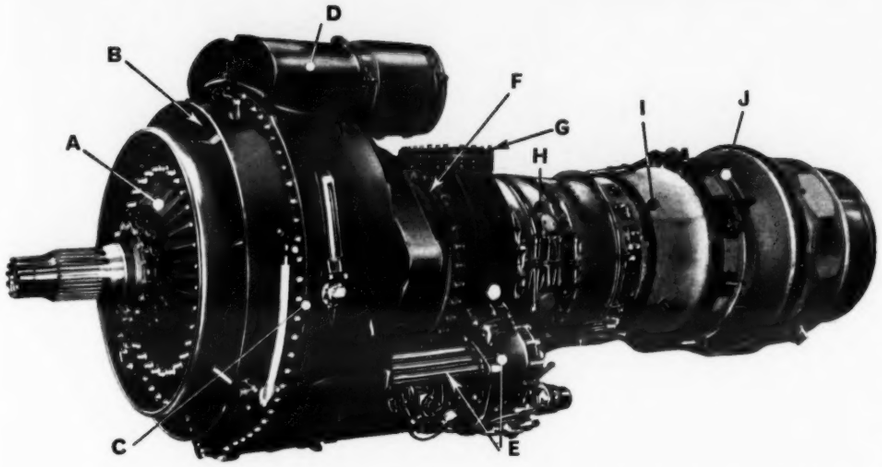
The double-bubble is fundamental in providing the required layout at a reasonable structural weight and minimum aerodynamic drag. The larger upper radius gives the required cabin width, while the smaller lower radius provides a compact form for the underfloor holds. In other words, the cross-section is economical in frontal area, while the intersections of the two radii tie in with the floor to hold the pressurization stresses without undue weight—it's an old Boeing custom. Another advantage is, of course, a straight-run fuselage almost from nose to tail, with the wing box lying beneath it and only interrupting the freight bays.

Both manufacturer and operator extol the low sit of the freight compartment and the "headroom" within, but the sills are, in fact, shoulder high and one would have to stoop double to move up and down the long holds. In fact, the holds are intended for use with

Elevation and plan of the Vickers *Vanguard* fuselage.

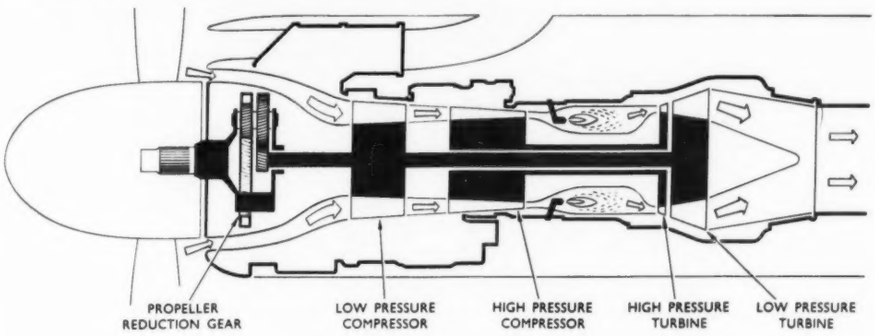


– VICKERS TYPE 900 –
Fuselage length 117'10"
83 Passengers 5 abreast 35" pitch.



The *Tyne* itself: A - reduction gear; B - annular air intake; C - integral oil tank; D - oil cooler; E - quill drives and accessory mounting pods; F - low-pressure compressor casing; G - air bleed; H - high-pressure compressor casing; I - annular combustion chamber; J - turbines.

Rolls-Royce diagram of the *Tyne* interior and nacelle mounting.



packaged freight and luggage, offered up on fork-lifted pallets that will run along rails in the holds.

The diameter of the airscrews, 14 ft. 6 in., limits the minimum wing height, and fuselage ground clearance dictates the upward sweep of the tail. Seating requirements make the fuselage parallel in plan almost throughout its length. Nevertheless, the "V-bomber" nose and swept-up tail do much to dispel that tube-look and make the *Vanguard* an eyeable aeroplane. Moreover, the shape looks aerodynamically sound—and more than one designer today has extolled the economic advantages of only a 2 m.p.h. cruising-speed gain when extrapolated over a year's operation.

The wing plan is similar to that of the *Viscount,* which was itself recognisably like that of the *Viking* and the *Wellington.* If taper and aspect ratios have followed a tradition, wing thickness ratios have been progressively reduced, as befits hundred mile-an-hour jumps in cruising speed.

The rectangular tail surfaces will have less dorsal fin than the *Viscount,* presumably because of the more effective side area of the deeper fuselage—although one would not be surprised to see a dorsal extension later. Once again, tail plane dihedral is used to supplement the true fin area.

The nacelles for the Rolls-Royce *Tynes* will be long and cylindrical, like those of the *Dart,* with annular engine air intakes plus an oil-cooler scoop on top—the diameter is virtually identical even though the power is doubled. The inner nacelles are placed well out from the fuselage in the interests of cabin noise level. The jet pipes are led over the wing.

The Rolls-Royce *Tyne* itself is a completely new engine and the first from that company with a free turbine. This fact, plus the large reduction-gear ratio of 0.062 : 1 should result in a low airscrew r.p.m. If the free-turbine *Proteus* in the *Britannia* is typical, the result should be very quiet, even at take-off power. The *Tyne* (née RB.109) went on the bench in mid-1955 at reduced power and was approaching its initial rating of 4,000 s.h.p. by the end of the year. It is credited with a development capacity of some 5,000 s.h.p. It is initially being flight-tested in the nose of one of Rolls-Royce's *Lancasters* and is later to be given "airline experience" in an Airspeed *Ambassador* prototype. Airscrews with solid-forged light-alloy blades and equipped for feathering, reversing and auto-coarse pitch have already been designed, both by Rotol and de Havilland.

The tricycle landing gear of the *Vanguard* will consist of a nose wheel retracting under the cockpit floor and twin-wheel main legs which will be raised forward into the inner nacelles. The latter lead to a bulkier nacelle than would be the case with bogies, since the weight of the aeroplane requires large tyres. The choice was made because wheels allow more rapid manœuvring than do bogies, with a consequent saving in precious ramp time. Retraction will be hydraulic with mechanical uplocks and down locking by a free-fall fitting. Anti-skid brakes will be fitted.

Structure

The manufacturers have been particularly reticent regarding the structure. However, one knows that Vickers has a way of developing its traditional structures; there are distinct trends running through the design of the *Viscount, Viking* and *Wellington* wings. In the case of the *Vanguard,* one could reasonably expect an infusion from the *Valiant,* which has a torsion-box spar. Vickers also learns by experience, the *Viscount* had the spar fatigue weaknesses of the *Viking* eradicated, and the presence of Litherland Teed*) in the company should *de facto* preclude any possibility of fatigue. B.E.A. also has some ideas on the subject, chief of which is that the main stress-bearing structure must be easily inspected—preferably externally—for cracks before any major fault can develop. The box spar construction will include integral tanks, instead of the bags used in the *Viscount.*

* Major Philip Litherland Teed is Vickers-Armstrongs' Chief Metallurgist and a noted authority on fatigue of aircraft structures.

Accommodation and Services

Airliner progress in the decade since the war is exemplified by the way in which the *Vanguard* has been designed round its payload —instead of making a neat aeroplane and then scratching heads about where to put the bodies and the bags!

Masefield also emphasised that he intended to have the highest passenger standard ever; this meant low noise level, elbow-room, pleasant view and amenities. The *Viscount's* quiet cabin is to be improved upon, with no seats near the airscrew zone. The fuselage width allows five-abreast seating with an eighteen inch aisle and thirty-nine inch pitch. The *Viscount's* fine large elliptical windows—which allow passengers to see from the *opposite* side—have been retained, one to each seat row. Learning from the queues at the *Viscount's* single toilet, both operator and manufacturer have decided upon no less than four—one to 25, rather than one to 60. Fore and aft pantries, plus a bar, should ensure good service in all three cabins. Two vestiaires seems small accommodation for nearly a hundred coats.

Vickers sketches suggest the abandonment of those excellent, convenient and spacious-looking plastic net luggage racks, which would be a pity, since they are more adaptable than shelves and, for the shorter passengers at least, militate against forgetfulness.

The main passenger doors, on the port side, are to be rectangular, with large corner radii, instead of the *Viscount's* even-stress elliptical shape. Power-operated air stairs are to be standard—they are shortly coming in on Capital Airline's *Viscounts*. Smaller servicing doors in the port side opposite the main doors, plus removable windows over the wing and adjacent to all four doors combine to exceed the emergency-exit requirements of the A.R.B. and the C.A.A.

The large pressurised holds have space for more than the luggage and residual freight weight with a full load of passengers. The reason for this is to be able to make up a freight payload when the passenger load factor is down in the winter. Actually a full freight load by weight can be carried up to a 30% passenger load factor—at a profit. B.E.A. has found that not only is the carriage of freight in the cabin inconvenient, since it severely limits the dimensions of the loads, but it is very deleterious to the furnishings—hence the double-bubble and the holds.

The cabin will be air-conditioned to 21 deg.C (70 deg. F), the equipment being designed to achieve this from -60 deg.C (-76 deg.F) to 35 deg. C (95 deg. F) at 65% humidity. Because of the large total volume of the cabin and the two freight holds, Vickers has deemed it advisable to have two engine-driven blowers instead of using the L. P. compressor tappings available on the *Tyne*.

The main electrical services are to be supplied by four engine-driven 28-volt starter-generators. De-icing services (airscrews and tail) will receive alternating current from four engine-driven alternators. The wing will be de-iced by hot air tapped from the engines.

A common 2,500 to 3,000 lb./sq.in. hydraulic system will be used to serve the flaps, undercarriage, nosewheel-steering and brakes. The air stairs will have an individual electro-hydraulic system which will be off-loaded during flight.

Handling

The B.E.A. specification particularly called for an aeroplane which would be able to use all existing airports in the network, including Jersey. The estimated approach speed of the *Vanguard* at maximum landing weight is actually lower than that of the *Viscount* under similar conditions.

The *Vanguard* will be a fast aeroplane, cruising initially at 400 m.p.h. with the *Tynes* at the 4,000 s.h.p. for take-off rating, later rising to 425 m.p.h. The clean aerodynamic form suggests that when the *Tynes* reach their 5,000 s.h.p. level the *Vanguard* will be cruising at over 450 m.p.h.

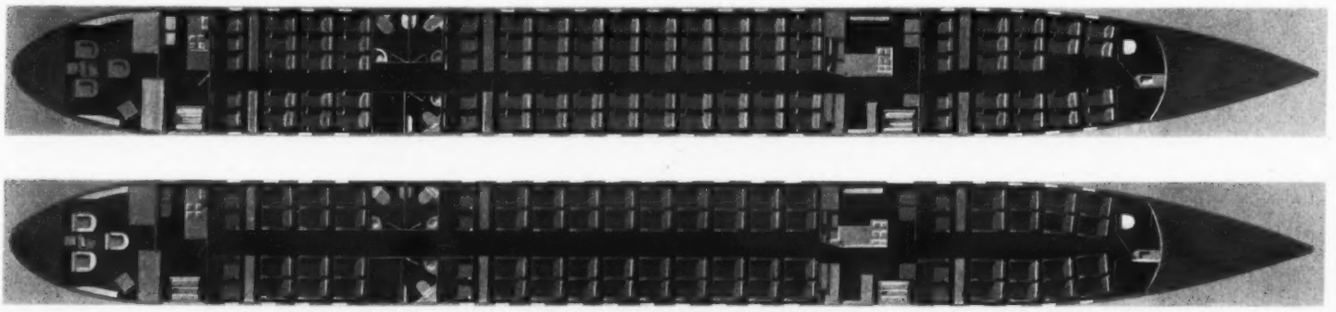
Simplicity is exemplified by the fact that the controls will be manually operated with aerodynamic balancing, and the landing performance is to be achieved with unassisted high-lift flaps.

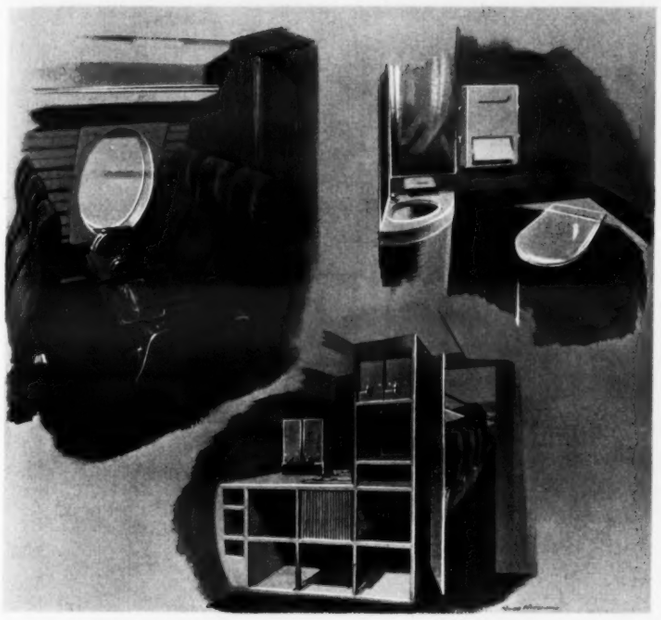
Maintenance and general ground handling is to be simple and easy. The *Dart* and the *Viscount* already have high reputations in this respect and it is certain that the prime customer B.E.A. (whose heads of engineering are vigorous and forthright) will insist upon an even higher standard.

It is impossible to comment further upon performance or economy simply because no figures are available. The *Vanguard,* however, comes from the manufacturers with the most turboprop airliner experience in the world, and, moreover, a company which has always shown the ability to profit from experience. The specification was issued by a most exacting customer, a customer which is determined to see that all its needs are exactly met. The power plant, although new, is being supplied by the premier aero-engine manufacturer in the world.

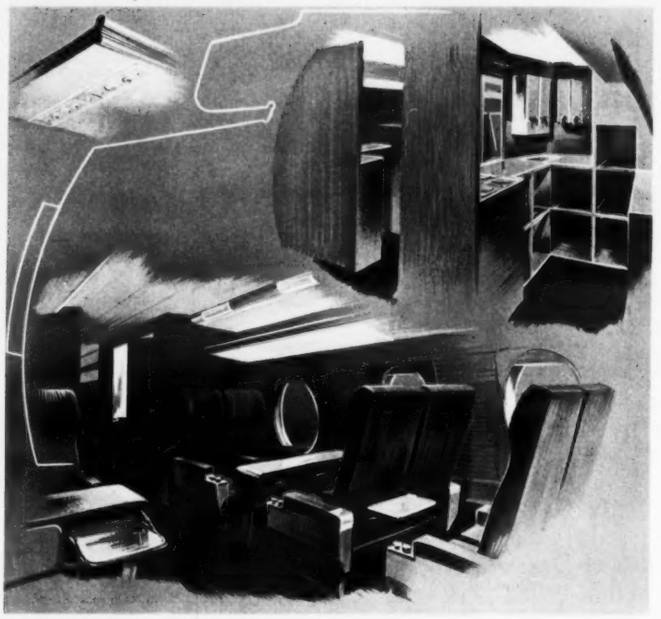
These facts should ensure that the aeroplane will be the very best that can be made within the requirements. It is obviously designed to make a profit under the conditions operating within B.E.A. Furthermore, it has *got* to be right, since there is no government prototype finance, nor likely to be under present policy—although there is a grant toward *Tyne* development. Whether this aeroplane will also suit the pattern of other operators remains to be seen—the maximum range of 2,500 miles is specifically aimed at the U.S. domestic market.

Two Vickers sketches of the interior of the *Vanguard* for 93 seats (B.E.A. version; top) and 76 seats (bottom).





Vickers artist's impressions of the 93-seat interior: starboard seats at rear of main cabin; rear starboard toilet; forward pantry looking aft into main cabin.



Artist's impressions of the 76-seat interior: passenger call panel (top left); main pantry (top right); starboard seating in forward part of main cabin, with typical Vickers tables between facing seat rows.

The worldwide success of the *Viscount* and the *Dart* are excellent sales factors for the *Vanguard/Tyne* combination. Vickers expects to fly the prototype in 1958 and to deliver the B.E.A. fleet during the following year. George Edwards expresses his confidence in maintaining the *Viscount* programme plus this new commitment—the cancellation of the V.1000 must ease the floorspace and personnel pressure—but it is likely that overseas airlines may prove less sanguine. It should, however, be borne in mind that Vickers has very large resources and has kept quite close to its *Viscount* and *Valiant* programmes during a difficult period.

As we go to press, it seems that the departure of Peter Masefield from B.E.A. has encouraged Vickers-Armstrongs to work on the long-range "International" version—the *Electra's* rival—before completing the detail design of the B.E.A. contract. This may well cause some changes in the wing plan form and, perhaps, even the nose, since crew arrangements will obviously be very different.

A model of the Vickers *Vanguard*.

Data and Design Performance of the Vickers-Armstrongs V. 900 Vanguard

Dimensions

Span	118 ft.
Length	117 ft. 10 ins.
Height	34 ft. 9 ins.
Wing area	1,525 sq. ft.
Aspect ratio	9.1
Fuselage external diameter (passenger deck)	11 ft. 6 ins.

Loading data

Cabin width	10 ft. 9 in.
Aisle width, 5 seats abreast	1 ft. 6 in.
Level floor length	93 ft. approx.
Freight volume (underfloor)	1,400 cu. ft.
Height	4 ft. 3 in.
Floor length, forward	28 ft. 6 in.
aft	24 ft. 9 in.
Door width	5 ft. 6 in.
height	4 ft. 3 in.
Sill height above ground	4 ft. 8 in.

Weights

Gross	104,000 lb. approx.
Payload, max.	21,000 lb

Performance

Cruising speed	400–425 m.p.h.
Cruising altitude, max.	30,000 ft.
Range, max.	2,500 s. miles

Power plant data

Take-off power	4,020 s.h.p. + 1,175 lb.t. 4,470 e.h.p.
Cruise, representative, 425 m.p.h. at 25,000 ft.	2,270 s.h.p. + 150 lb.t. 2,470 e.h.p.
Specific consumption	0.414 lb./e.h.p./hr.
Length	8 ft. 1 in.
Height	3 ft. 4.5 in.
Width	3 ft. 1.4 in.
Dry weight	1,880 lb.
Specific weight	0.42 lb./e.h.p.
Reduction gear ratio	0.062 : 1
Pressure ratio	12 : 1

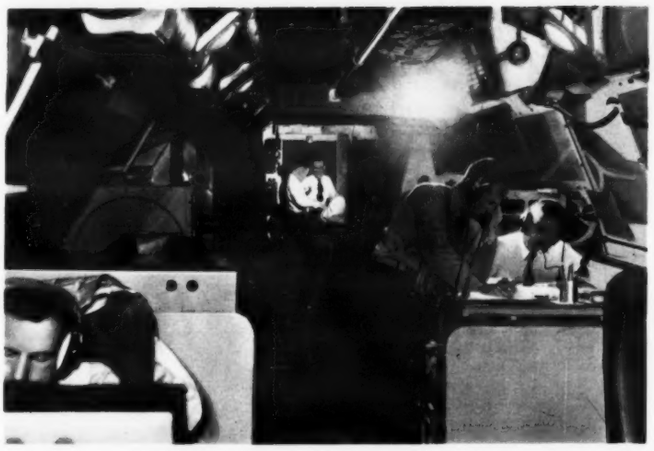
A Lockheed WV-2 radar warning aircraft on a training mission over the State of Maryland.

Radar Patrol

America's air defence problem differs vastly from that faced by Europe, chiefly because the Americans can count on a warning period of several hours instead of minutes, as in Europe. But the Americans, and the U.S.A. in particular, have paid a high price for their additional security: in cooperation with the Canadians they have built three parallel radar warning lines right across the northern part of the Continent, they are erecting artificial "radar islands" off their coasts, they have commissioned radar picket ships, and they have built up fleets of high-altitude reconnaissance and early-warning radar intelligence aircraft operated both by the U.S. Navy and the U.S. Air Force.

The photos on these two pages show a naval air crew at work aboard a Lockheed WV-2 (U.S.A.F. designation: RC-121C) radar patrol aircraft on a training flight—which may last up to 24 hours non-stop. Developed from the *Super Constellation* commercial transport and powered by 3,250 h.p. Wright Turbo-Compound engines, the WV-2 carries about five and a half tons of radar and electronics equipment. This includes height-finding radar in the "hump" on the fuselage top and distance-measuring radar in the under-fuselage "belly", as well as very complete navigation equipment, such as storm-warning radar, Loran, etc. A crew of up to 31 men, relief pilots, radar operators, radar technicians and maintenance men perform their duties in the aircraft. Aboard are five surveillance radar consoles plus auxiliary radar units which permit observation of different segments of the same basic radar picture. All information thus gained is transmitted to the airborne Combat Information Centre (CIC) which coordinates the search information and communicates it to the home base, to ships, or to other aircraft.

The WV-2 has a maximum take-off weight of about 140,000 lbs., including 8,750 U.S. gals. of fuel. Its wing span is approximately 123 feet, its length 114 feet.



Most important compartment of the WV-2 is the Combat Information Centre Room. Radar consoles are at left.

Lieutenant Commander John P. Cheney, foreground, plots targets reported by scope operators Lt. Cdr. Clifford McLein and Lt. Jeremiah Denton on a transparent plotting board.

Copilot Lieutenant Ben Spence at the controls of the WV-2.

A modern galley aboard the WV-2 is necessary for long flights. Here Aviation Ordnanceman Peter Matpos is preparing to fry eggs over an electric stove.

Bunks and reclining seats are provided for relief crewmen aboard the WV-2 during reconnaissance flights, which may last up to 24 hours.

Five WV-2 early warning radar aircraft are lined up on a taxi strip at the Naval Air Station at Patuxent River, Maryland, ready to take off for a reconnaissance training mission.

SAAB BT-13

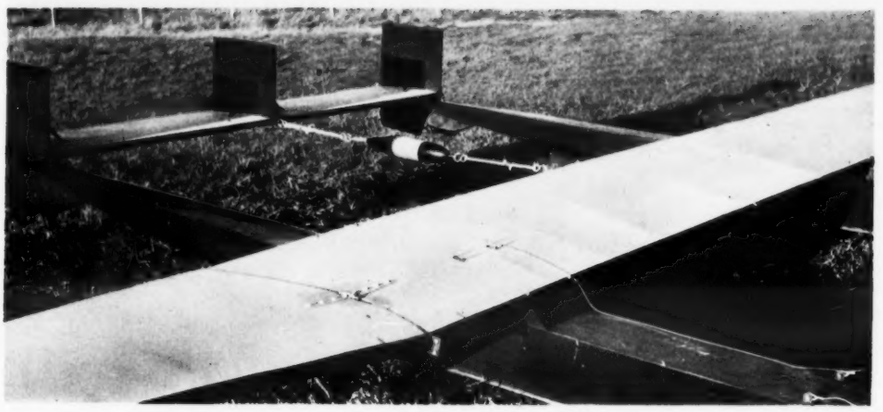


Fig. 1: RFD type wing target with microphone transmitter for the Saab BT-13 Hit Indicator (between tail and wing).

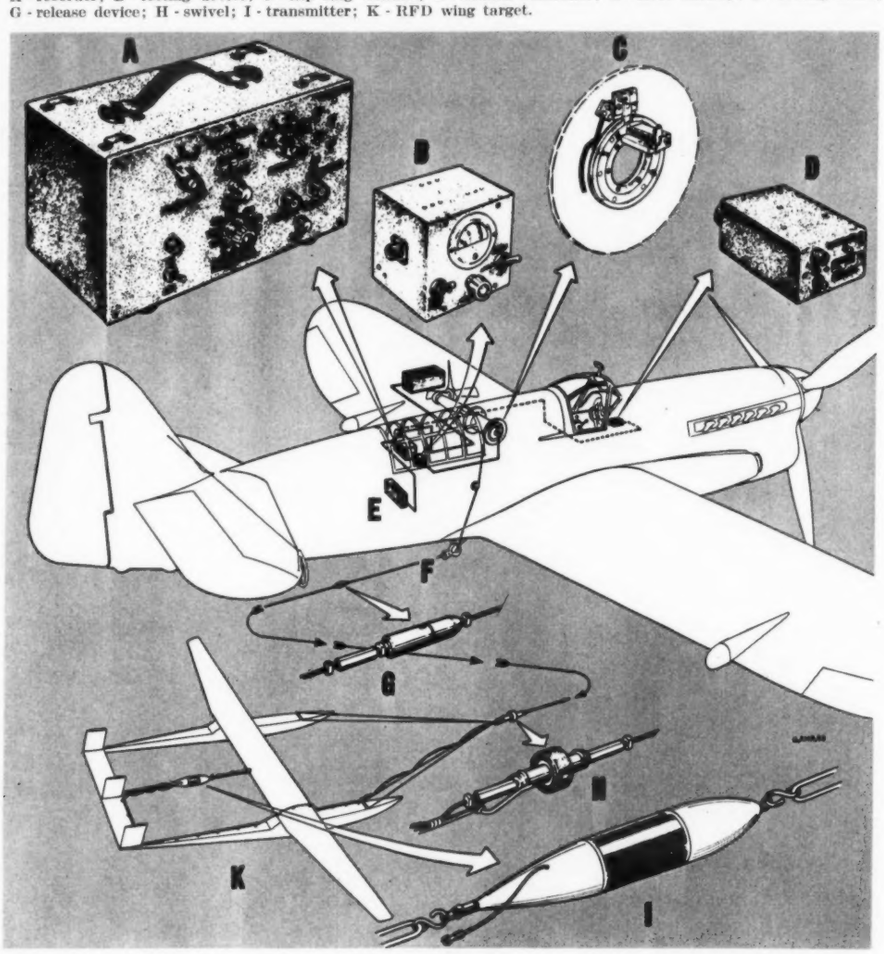
An Electronic Hit Indicator

Saab Aircraft Company, of Linköping, Sweden, has developed a hit indicator, known as the Saab BT-13, which greatly facilitates the training of aircraft and anti-aircraft gunners.

Instead of firing on a sleeve target and counting the hits after the sleeve has been dropped to the ground, it is now possible for the gunner to get a report direct by radio in a matter of seconds. The target itself reports the result—the number of hits—direct to the towing aircraft from which a radio report is sent to the gunner. The BT-13 can be used for air-to-air, ground-to-air and air-to-ground firing with arms of all calibres between 8 and 105 mm. The advantages of this equipment are

- The gunner gets his result immediately so that he can fire again directly afterwards and correct his aiming technique.
- The signals can be connected to the normal radio transmitter in the towing airplane, so that the gunner can directly listen to his hits.
- The sensitive zones of the target can be changed in size according to the ability of the gunners.
- The expendable items are cheap and easily replaced.
- Use of the BT-13 increases the interest of the gunners and thus shortens training periods. This will be followed by lower costs for fuel, ammunition and maintenance.

Fig. 2: Main components of the Saab BT-13 Hit Indicator as installed in a Fairey *Firefly* towing a RFD wing target: A - recorder; B - testing device; C - slip ring contact; D - remote controller; E - H.T. battery; F - towing cable; G - release device; H - swivel; I - transmitter; K - RFD wing target.



The theoretical background

Projectiles passing through the air at supersonic speed produce shock-waves of conical appearance. This shock-wave actuates a "transmitter" consisting mainly of a microphone, which is placed in the target. The microphone transduces the pressure wave into electrical impulses, which are led through a specially designed cable to a recorder with a counter that reports the number of hits. The functioning of this vital part is shown in a block diagram in *figure 3*. The signal first passes a rheostat—the *Wire Length Compensator*—which must be set in a position to compensate for resistance and

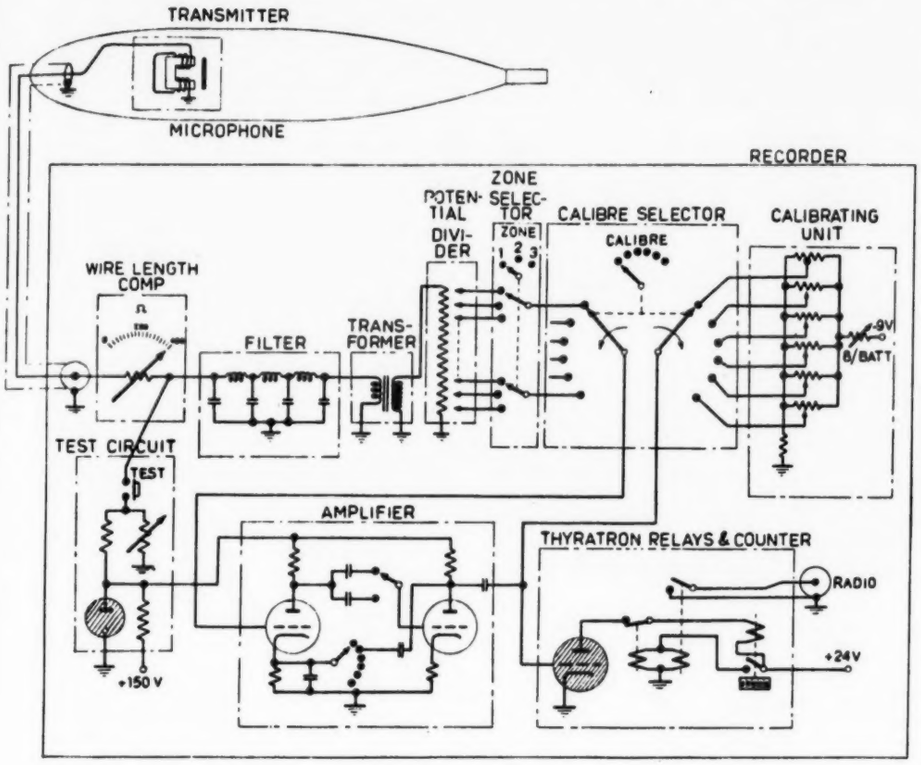


Fig. 3: Block diagram of recorder and microphone transmitter.

inductance of different wire lengths. The impulses then go to a *filter* which sorts out electrostatic noise and interference from other radio transmitters. Having passed the filter, the signal will be transformed in a *transformer* where the intensity is raised to a higher voltage level, from which it passes to a *potential divider* with many terminals. One terminal is used for each zone size and calibre. It is chosen by the *Calibre Selector* and the *Zone Selector*. The Calibre Selector also operates a negative feed back to the amplifier and the negative grid-bias on the thyratron, so that both sensitivity and frequency characteristics of the recorder can be varied, and the "volume" of the target modified.

The *amplifier* is a specially designed two-valve low frequency type.

The thyratron has a negative grid-bias from a battery, which can be set to the correct value by means of the potentiometers in the calibration units. The thyratron triggers the counter device as soon as an impulse from the amplifier exceeds a given value.

For calibration of the recorder prior to use there is a special *Test Circuit*. The calibration is made by means of a pressure button which, at each operation, gives a constant voltage pulse that is used for setting the recorder to the required sensitivity.

If the recorder cannot be placed within easy reach of the pilot in the towing plane (or the observer in a two-seater), a *remote controller* is used. This is a small box with a counter, an indicator lamp and a switch. The remote controller is connected to the recorder via a shielded cable.

To enable a rapid check to be made of the transmitter and cable during flight, a testing device is installed in the cockpit.

The *Transmitter* consists mainly of a microphone, the characteristics of which give the "volume" of the target. The microphone is surrounded by a double screen built up by two perforated tubes covered by wire meshing and plastic cloth. This configuration serves as an acoustical filter and at the same time protects the microphone from dust.

The towing cable is of a special design, provided with a conductor in the centre insulated from the outer stress-bearing steel part. The cable can be used several times. If it is hit near the transmitter, the end of the remaining part can be fitted to the transmitter and the cable can be used again.

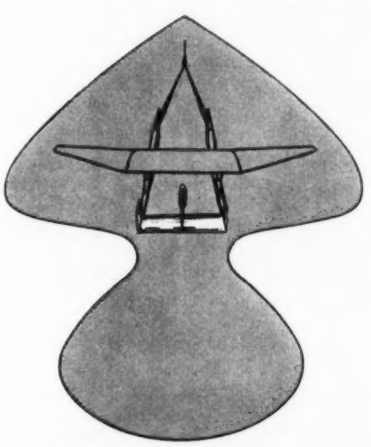
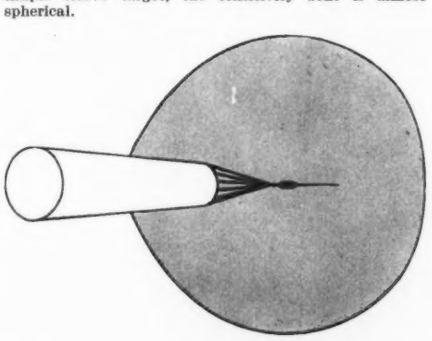


Fig. 4: Sensitivity zone of the BT-13 Hit Indicator used with a RFD wing target which is fired on from 45° behind and above.

Fig. 5: When the BT-13 is used in conjunction with a simple sleeve target, the sensitivity zone is almost spherical.



Practical application

The installation of the Hit Indicator in a Fairey *Firefly* and a RFD wing target can be seen in *figure 2*. The installation shown is used in Sweden by a civil company, Svensk Flygtjänst, which does target flying for the Swedish Army and Navy and sometimes also for the Air Force.

Figure 2 shows a wing target, but BT-13 is also used for sleeve targets in which case the transmitter is placed in front of the sleeve. The forms of the "zones" i. e. the volume, in which the hits are recorded, are different for a wing target and a sleeve. In the first case the wing target gives reflecting and screening effects producing a zone section as shown in *figure 4* when firing 45° from behind and above. *Figure 5* shows a side-section of the lime-shaped zone when the transmitter is used free or in front of the sleeve target.

The tolerances of the zones are between $\pm$ 25 and $\pm$ 40%, depending on the shell calibre used. The BT-13 target cannot indicate if a "hit" is in front of, behind, below or above it. Like all electronic equipment it requires good maintenance.

The BT-13 has already aroused considerable interest in many countries and is used as a regular device in Sweden (Air Force, Army and Navy), Denmark (Air Force), Britain (Air Force and Navy), and Holland (Air Force). It has also recently been sold to the United States, Australia, Yugoslavia and Italy. During the past year, the BT-13 has been used at gunnery demonstrations by such world famous firms as AB Bofors and Contraves Italiana, proving its ability to give rapid scoring results.

What's in the Air?*

AIR TRANSPORTATION

• Air transport in 1955

I.C.A.O. statistics reveal that the scheduled international and domestic airlines last year carried 69,000,000 passengers, or 10,000,000 more than in 1954. Each individual journey averaged 559 miles. The distance flown by aircraft operating on regular scheduled services amounts to fifteen times the distance from the earth to the sun.

• Air Austria

The foundation of an Austrian airline, known as Air Austria, is announced from Vienna. The share capital of 30,000,000 schillings has been subscribed by private enterprise, three State banks, with 7,800,000 schillings being contributed by K.L.M. Manager is Oskar Reichel von Erlenhorst. The Board of Directors comprises twelve members from Austrian business circles and three members of the K.L.M. management. The company has already applied to the Transport Ministry for operating authorizations. — Services planned for a start are Vienna-Belgrade-Athens-Cairo, Vienna-Moscow and Vienna-Düsseldorf-Amsterdam. Aircraft for initial use will be two Douglas DC-4s belonging to K.L.M., and a preliminary contract has been signed for the purchase of four Vickers *Viscount 803s*. Air Austria's first four pilots are being trained by K.L.M. for DC-4 service.

• Five-year plan for L.A.I.

Linee Aeree Italiane has published an expansion programme for the next five years. Main points are plans to operate turboprop aircraft (probably Bristol *Britannias*) on North Atlantic services during 1957 and jet aircraft (the DC-8 is mentioned) in 1960. Extension of the Rome-Teheran route to Calcutta and Tokyo and an increase in the frequency of services between Rome and New York are also projected. Special attention is also to be given to expansion of European and domestic operations.

* Extracts from *Interavia Air Letter*, daily international news digest, in English and French. All rights reserved.

Signature of the technical cooperation agreement between *Fiat* and *Bristol* by Sir Reginald Verdon Smith, Managing Director of Bristol Aeroplane Co., (left) and Engineer Gaudenzio Bono, Managing Director of Fiat. Second from left, Engineer Giuseppe Gabrielli, Manager of Fiat's Aviation Division. Far right, Group Captain M. Pinfold, British Air Attaché to Italy.

• S.A.S. Trans-Arctic Tokyo Route Plan

Scandinavian Airlines System plans to open a route across Canada's Far North to Tokyo. Negotiations are already under way between S.A.S. and Canada to establish the necessary radio support facilities at Resolute, near the 75th Parallel, and possibly other points. Radio check points are also to be established in the Norwegian Lofoten Islands, on Spitsbergen, in the north-east corner of Greenland and at Anchorage, Alaska. A weekly service may be inaugurated in the autumn.

• Air transport agreements

The air transport agreement signed a year ago between Sweden and Syria has now been ratified by both countries. — The Yugoslav State airline J.A.T. and the Polish State airline L.O.T. have concluded an agreement on the operation of the Warsaw-Belgrade route. The twice-weekly service is to be run by the two companies alternately. — Spain and Peru have ratified the air transport agreement previously concluded between the two countries.

• Interest in Fokker Friendship

United Press reports from Seattle that West Coast Airlines Inc. has taken an option on six of the first production models of the Fokker F.27 *Friendship* at a cost of $ 500,000 each (excluding spares and radio equipment). West Coast is thus the first airline to plan operation of the *Friendship*. The F.27 is being built under licence in the United States by Fairchild Engine and Airplane Corp.

• National orders 20 Electras

National Airlines has placed an order for 20 Lockheed *Electra* turboprop aircraft to a total value of $ 46,000,000. The first twelve models are to be delivered by the end of 1959, and the remaining eight during 1960. This order increases Lockheed's backlog for the *Electra* to 104 aircraft; value, more than $ 200,000,000.

• Boeing 707 and Douglas DC-8

The run on jet aircraft is in full swing. The following table shows the orders that have been placed so far:

Airline	Boeing 707	Value in $m	Douglas DC-8	Value in $m
Pan American Airlines	20	109	25	160+
American Airlines	30	135	—	—
United Air Lines	—	—	30	175
National Airlines	—	—	6	36
Eastern Airlines	—	—	18 (+8)*	165
Continental Airlines	4	21,3	—	—
Braniff Internat. Airways	5	30	—	—
Air France	10	71	—	—
K.L.M.	—	—	8	50+
Sabena	3	14,45	—	—
S.A.S.	—	—	7 (+3)*	app. 50
Japan Air Lines			4	27+
Panagra			4	25

* These figures represent options already regarded as more or less firm. Prices quoted include accessories; differences in prices are due to additional equipment ordered by some airlines.

• Death of Captain A.G. Lamplugh

The British Aviation Insurance Co. Ltd. announces the death of its Board member Captain A. G. Lamplugh, at the age of 60. Captain Lamplugh had been a leading figure in aviation insurance for

Death of Ralph S. Damon: Ralph S. Damon, President of Trans World Airlines, died at Nassau Hospital, Mineola, Long Island, on January 4th after a short illness. He was 58. Damon took over the presidency of T.W.A. in January 1949.

Air Chief Marshal Sir Basil Embry, who has retired from the Royal Air Force and resigned his post as Commander, Allied Air Forces, Central Europe, has been created Grand Commander of the Order of the Bath by Queen Elizabeth II.

Air Chief Marshal Sir George Mills has succeeded Air Chief Marshal Sir Basil Embry as Commander, Allied Air Forces, Central Europe.

Curt W. Kauffmann, head of K.L.M.'s Swiss offices, retired from the company on January 1st, 1956, after 35 years service. For a number of years Kauffmann was also Chairman of the Dutch Chamber of Commerce.

Hughes XH-17 heavy experimental helicopter, which reached a speed of 68 m.p.h. plus during tests at a gross weight of more than 20 tons.

36 years and until his retirement and election to the Board in September 1955 had been Underwriter and Principal Surveyor for the company since its formation.

AVIATION POLITICS

• I.C.A.O.'s 1956 technical assistance programme

The International Civil Aviation Organization's technical assistance programme for 1956 includes regional projects in Latin America and the Middle East and individual aid to 27 countries at a cost of $ 1,146,750.

• Reduction in Federal aid for Swissair

The financial situation of Swissair and its position in international air transport have so far improved during recent years that the company can dispense to a large extent with Government aid. Under new agreements with the Federal Posts and Railways Department, Swissair is acquiring the two Douglas DC-6B long-range aircraft originally purchased by the Confederation and chartered to the airline. The price to be paid is the original purchase price minus the charter fees already paid. Swissair also plans to renounce the Federal guarantee for depreciation of its fleet. The company thus regains its earlier freedom of action, in particular with regard to depreciation policies.

SERVICE AVIATION

• U.S.A.F. orders more B-52 bombers . . .

The U.S. Air Force has announced orders for an additional 30 Boeing B-52 jet bombers at a cost of $ 8,000,000 each. — The report appears to confirm the view held in American aviation circles that the Air Force plans to raise the number of its B-52 wings from the eleven originally projected to twelve and reinforce each wing with six additional bombers.

• . . . and Convair F-102As

The Convair Division of General Dynamics Corporation announces the U.S. Air Force's biggest order so far for the F-102A all-weather jet fighter and the TF-102A jet trainer. Neither the number of aircraft ordered nor their dollar value have been revealed. The F-102A began flight testing at the end of October 1953, while the first TF-102A has recently been sent to Edwards AFB, California, for testing.

• Boom in the U.S. aircraft industry

The U.S. aircraft industry reports record results in both production and sales in 1955. The value of aircraft, engines, propellers and spares sold reached $ 8,400,000,000, an increase of $ 100,000,000 over 1954. Military production accounted for 85 to 90% of total deliveries, with a monthly average of 700 military aircraft leaving the production lines. Sales of civil aircraft amounted to 4,500 in 1955, roughly 1,000 more than in 1954. Total order backlog on September 30th, 1955 stood at $ 13,900,000,000.

• Sperry Rand expansion plans

Sperry Rand Corporation, one of the United States' leading electronics firms, plans to erect an aeronautical research division in Phoenix, Arizona. The new division will include an advanced flight research centre and a manufacturing plant for the development of electronic equipment for aircraft use. Sperry officials say they selected Phoenix as the site because its near-desert climate permits year-round flying for research.

• Curtiss-Wright buys up P.R.C.

Curtiss-Wright Corporation has announced the acquisition of Propulsion Research Corporation, of Santa Monica, California, an organization of development engineers engaged in research, design, testing and project management of primary propulsion units and accessories. The California firm will continue to function as an independent corporation under the same management, with heavy emphasis on advanced aircraft power plants.

• Bristol Airplane Co. of Canada (1956) Ltd.

After four years of preparation and the expenditure of $ 6,000,000, the Bristol group has announced a re-organization of its Canadian set-up. A new parent company, Bristol Airplane Co. of Canada (1956) Ltd., has been formed, with headquarters in the International Aviation Building, Montreal. It will control the following subsidiaries: Bristol Aero Engines Ltd., Montreal, Bristol Aero Engines (Western) Ltd., Vancouver, and Bristol Aircraft (Western) Ltd., Winnipeg. First items on the production programme will be the *Sycamore* and Bristol 173 helicopters.

• Second European Aeronautical Congress

The second European Aeronautical Congress, to be organized by the Dutch Aeronautical Engineering Association (Vereniging voor Luchtvaarttechniek), is to be held at Scheveningen from September 25th to 29th, 1956. Subjects discussed will cover the whole of aeronautical engineering with the exception of guided missiles and astronautics. — The decision to hold a European Aeronautical Congress every two years was taken by the Association Internationale des Constructeurs de Matériel Aéronautique (International Association of Aircraft Manufacturers) in 1953. The first Congress was held in Paris in 1954.

An old Fokker F-VII, presented by Fokker and K.L.M. to the Dutch Air Museum, was flown to Schiphol by two K.L.M. pilots who operated the old services with this aircraft. The official handing over of the aircraft by F. J. L. Diepen, Fokker Manager, and General I. A. Aler, K.L.M. President, was attended by numerous veterans of Dutch aviation. Left, the youngest member of the Fokker family, the F.27 *Friendship*.

FLYING EQUIPMENT

● *Avro Aircraft Ltd.,* of Malton, Ontario, has begun working on a project for a *supersonic jet commercial transport*. Object is to develop a long-range transport to replace the jet types (Boeing 707, Douglas DC-8) due to come into commercial service in 1959-60.

● The prototype of the *Avro CF-105* twin-jet delta-wing all-weather fighter is scheduled to begin flight testing this summer. The aircraft, which is to have supersonic speed, will be fitted with Pratt & Whitney J-75 turbojets; later versions may, however, be powered by Canadian *Orenda PS-13* engines.

● A small experimental aircraft, the M-232, for extremely short take-off and landing runs is nearing completion at Fairchild Engine & Airplane Co.'s Hagerstown, Maryland, plant. The M-232 is fitted with two Lycoming GO-580 piston engines of 400 h. p. each and over-size Sensenich wooden propellers (diameter 13 ft.). — Span 39 ft., length 29 ft. 6 ins., gross weight approx. 7,000 lbs.

● The first *Douglas C-133* heavy turboprop transport was completed at the end of January. The first flight will take place shortly.

● Production of the *Lockheed C-130 Hercules* four-turboprop military transport is to be speeded up in 1956. Target is a monthly output of six aircraft.

● The *Beech 73* two-seat light trainer is powered by a Continental J-69-T-9 turbojet (925 lbs. thrust).

● A C.A.A. type certificate has been awarded to the six-to-eight-seat *Doman LZ-5* helicopter (one 400 h. p. Lycoming SO-580-D engine). The machine is also being tested by the U.S. Army under the designation YH-31.

● The *Dassault 550* light delta-wing interceptor has completed its first phase of works testing. It has now been taken to Brétigny Flight Test Centre for continued tests.

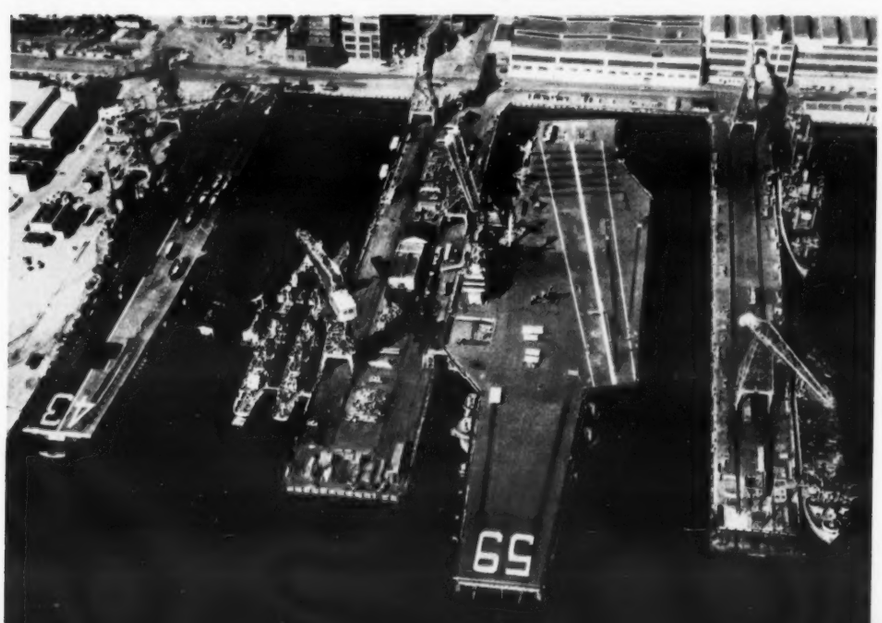
● The *Nord 1226* trainer, built by the French firm of *S.N.C.A. du Nord,* has begun flight testing at Melun-Villaroche. Power plant: one 170 h.p. S.N.E.C.M.A.-Régnier 4 L 02 with v.p. propeller. The Nord 1226 is derived from the older Nord 1221.

● A new division for vertical take-off aircraft has been added to Fiat S.A.'s research and development offices. Head: Professor G. Gabrielli.

● The 49 models of the *Bristol Britannia* so far ordered will be distributed as follows: British Overseas Airways Corporation 33 aircraft (15 *Britannia 100s,* seven *300s* and eleven *310s*); Royal Air Force (Transport Command) 6; Ministry of Supply 3; El Al Israel Airlines 3; Canadian Pacific Airlines 4.

Douglas DC-7C Seven Seas long-range commercial transport with Wright R-3350-18 EA 1 compound engines of 3,400 h. p. each. The first DC-7C began flight testing on December 20th, 1955, eleven days ahead of schedule.

An airship from the U.S. Navy base at Lakehurst, N.J., being refuelled by the aircraft carrier *Leyte* during naval exercises. The *Leyte's* pumps delivered 500 gallons of fuel via the 300-ft. pipe.



Flight deck of the 60,000-ton aircraft carrier *Forrestal,* here at anchor off Portsmouth, Virginia. The *Coral Sea* (left) and the two destroyers (at the same pier as the *Forrestal*) show how big a modern aircraft carrier is.

POWER PLANT AND MISSILES

● The *Fiat 4002* light experimental turbojet engine is to be the first in a series of small gas turbines for use in guided missiles, light trainers, helicopters, etc. A turboprop version is also planned. — Latest data: static thrust 550 lbs. at 26,000 r.p.m., dry weight 219.4 lbs., specific weight 0.398 lbs./lb.t., specific fuel consumption 1.25 lbs./lb.t., diameter 22.4 ins., length 40.7 ins.

● Approximately 48,000 running hours, including 12,000 in flight, have so far been recorded by the various versions of the *Bristol Proteus* turboprop. B.O.A.C. estimates for *Proteus 700* series engine hours for 1955-1958 are: 1955 — 10,000 hours; 1956 — 64,000 hours; 1957 — 273,000 hours; 1958 — 647,000 hours. — Corresponding figures for the Allison T-56 turboprop are given as follows for comparative purposes: 1955 — 5,000 hours; 1956 — 65,000 hours; 1957 — 300,000 hours; 1958 — 500,000 hours.

● *Rolls-Royce RTy. 1* is the official experimental designation of the *Tyne* turboprop version delivering 4,020 s.h.p. plus 1,000 lbs. residual thrust.

● Completion of a 150-hour type test is reported for the *General Electric J-79* jet engine; the J-79 is in the 12,000 lbs. thrust class (without afterburner).

● A rocket motor of undisclosed type with 20,000 lbs. thrust is to be fitted in the X-15 (North American) high-performance experimental aircraft.

● *Westinghouse J-54* is the designation of the turbojet engine of 6,500 lbs. thrust hitherto known under the works designation PD-33. Two J-54s are to be taken over by the U.S. Navy for testing and evaluating.

● The *Velvet Glove* missile developed by *Canadair Ltd.* has already been fired by F-86 and CF-100 aircraft.

● *Fairchild* is developing a guided missile known as *Goose* for the U.S. Air Force.

● The following technical data have been published for Japanese experimental rocket missiles:

Type	*Pencil*	*Baby S*	*Baby T*	*Baby R*
Length	9 ins.	38 ins.	42 ins.	46 ins.
Diameter	11/16 ins.	3 ins.	3 ins.	3 ins.
Weight	0.44 lbs.	15.4 lbs.	17.6 lbs.	17.6 lbs.
Top speed f.p.s.	558	1,312	1,312	1,312
Ceiling miles	—	2.5	2.5	2.5

Recording Flight Data in Commercial Aircraft

BY JEAN DE LAGARDE AND PAUL FÉTON, PARIS

J. de Lagarde

Air Chief Engineer Jean de Lagarde, *a former student of the Ecole Polytechnique, is head of the Flying Equipment and Certificate of Airworthiness section of the Directorate of Air Transport (Secretariat General of Civil and Commercial Aviation). In this capacity he is responsible for preparing airworthiness regulations for all French civil aircraft and takes part in international work on this question.*

Engineer Paul Féton, *who works for the same department, has been responsible for experiments with recording techniques. For a number of years he worked at the Acceptance Centre for Production Aircraft, which is now attached to the Government Flight Test Centre.*

P. Féton

The idea of in-flight recording is so attractive that it is surprising to find it so little applied in practice.

Although the recording of air-to-ground conversations is now generally accepted, no country or airline has yet taken any systematic measures to record the flight data of its aircraft. Yet the advantages of such a practice would be tremendous. The precise details obtained would help airlines to select and assess their crews and to improve the conditions of service and the life of their aircraft. Finally, such recorded information would be of valuable assistance in the investigation of many accidents.

The problem, however, is not a simple one, and none of the solutions so far proposed has produced equipment uniting the conflicting qualities of strength, accuracy, light weight, small bulk, economy and simplicity in operation that users are justified in demanding before accepting it for general introduction.

The following article describes the experiments carried out by the French authorities with the object not only of testing existing equipment, which was known from the outset to be far from perfect, but also of investigating the actual operational value of in-flight recording. The tests were made systematically in a number of aircraft in normal commercial service.

Equipment used

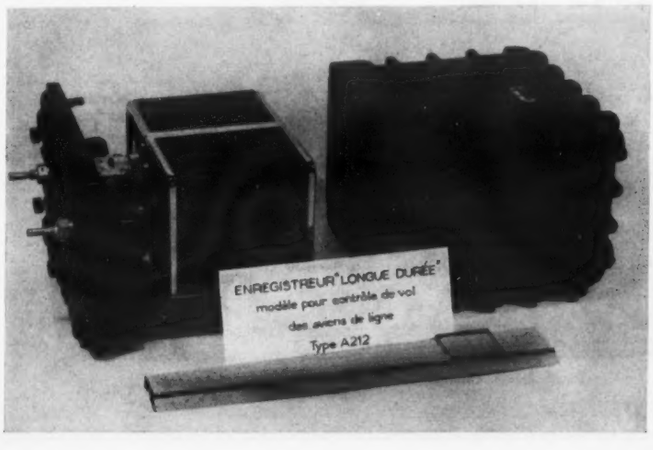
The experiments were carried out with recording equipment derived from that used at Brétigny Flight Test Centre to analyse the qualities of prototypes (performance and flying qualities) or other interesting phenomena.

The principle of these recorders is as follows : by means of suitable intermediaries, the value to be recorded produces a rotary movement in a small mirror which reflects in a dark chamber a ray of light from the filament of a lamp. A photographic film passes through the field swept by the reflected ray and when developed shows a continuous photographic trace of the fluctuations in time of the phenomenon recorded.

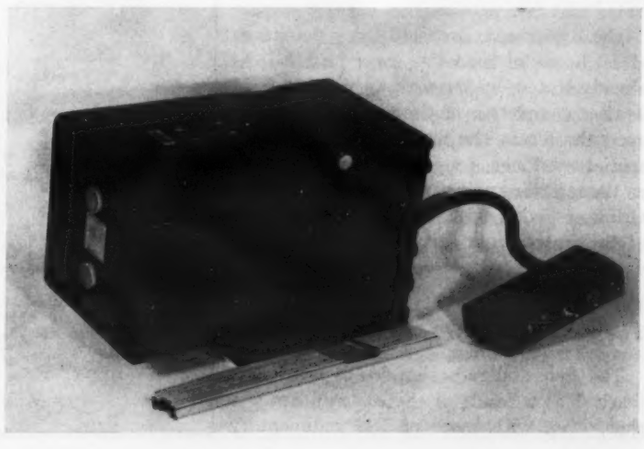
This system has both advantages and disadvantages compared with other known methods. Advantages include increased accuracy, thanks to the considerably lower inertia in transmission, as well as small bulk and low weight. Among disadvantages is the risk of light halo in the event of accidents and operating conditions that at first appeared more difficult but which have been more accurately assessed during the experiments.

No practical problem has a perfect solution. In the present stage of development photographic recording seemed to offer one of the best compromises between conflicting requirements, in particular because of the long experience already gained in the testing of prototypes. The only differences between the recorder used during the first year's experiments and the equipment employed for prototypes were of a minor nature ; for example, a longer operating time (50 hours)

Photographic recording equipment (type A 212) for measuring flight data of commercial transports, as used in the experiments: the light-proof casing has been removed (to the right).



The new long-duration recorder which is to be used in the next series of tests (1956). It incorporates a number of improvements, in particular a quick-change film magazine (left half of equipment).



and a lower film tape speed. The capacity of a recorder must be such that the longest two-way flights can be completed without changing the film. The speed chosen (approx. 10 cm an hour) entailed a film length of around 5 metres.

The equipment used was capable of continuously recording four parameters plus time, and of marking " vital actions " (operation of flaps or undercarriage, examination from outside to ascertain the time of a given observation, etc.).

Choice of values

The values considered essential for recording were altitude, air speed and heading, while the fourth value was left to the operator to select. This fourth " channel " was used for recording accelerations, the frequency of electric currents or engine values such as admission temperature, cylinder head temperature etc. In some cases the recorders were switched on when the doors were closed, in others when the undercarriage was retracted, depending on circumstances.

Scope of the experiments

Experiments were made in ten aircraft of various types (Douglas, Lockheed, Vickers), in which the necessary equipment was installed, during normal overhauls, between October 1954 and May 1955. Two airlines based at Orly took part in the tests. Installation and maintenance of the equipment and development of the films were undertaken by the makers of the equipment, who had a small photographic laboratory and workshop at Orly. Efforts were made to ensure that the scope of the experiment was wide enough to provide useful results, while at the same time concentrating resources so as to make the best use of available funds.

Between November 1954 and September 1955, 600 films were recorded during a total of 20,000 flying hours. The number of complete stoppages or failures of parts was very small in relation to the volume of recording (less than 10).

The equipment, prepared for a maximum of 50 hours of recording, was installed, as already stated, by the makers, who removed it after completion of the flights and developed the film. The firm also identified the special markings, prepared a critical report on the recording and passed the film on to the airline, together with the calibration curves of the instruments involved and any other useful indications.

The results

The first and most important conclusion reached as a result of the experiments was that, even with more or less rudimentary equipment, systematic recording is possible and does not hamper the crew. All the pilot is aware of is the brief appearance of the specialised operator who places the loaded equipment in position and removes it again after use.

The cost of recording cannot yet be properly calculated because of the experimental nature of the operation, but it can already be stated that the total cost, with the equipment so far used, does not exceed 500 francs ($1.50) an hour, including depreciation.

*

As already stated, the airline regularly received its films within a few hours of the aircraft's landing. The films can then be used for a variety of purposes.

Firstly, the information that can be obtained after a relatively short period of familiarization from a simple visual reading of the recording, compared with the crew's reports, is truly surprising. For example, a pilot's individual " style " can be recognized at first glance, however standardized training methods may be, and the chief pilot is very soon able to identify his subordinates without difficulty.

Moreover, he soon becomes sufficiently familiar with the typical outline for a given route to recognize immediately any abnormality. A baulked landing, for instance, is clearly distinguishable from a landing followed by a take-off, even if (as was sometimes the case) the recorder stops as soon as the wheels touch the ground and does not restart until weight is removed from them again (cf. recording of a flight from Orly to Zurich).

Again, a simple reading of the heading recording enables landing and take-off QFUs to be identified and major detours to be detected. Airline operational services will probably be content with this kind of information in the majority of cases and will

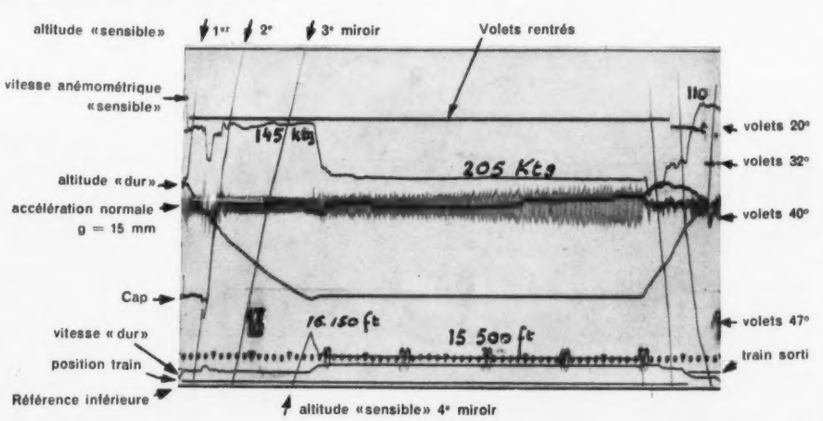
FIRST PRACTICAL EXAMPLE

Recording I is of a flight from Orly to Zurich-Kloten. It shows the altitude in two forms, firstly as a rough figure **(altitude " dur ")** and secondly more accurately **(altitude " sensible ")** with the aid of four successive mirrors **(1er, 2e, 3e, 4e miroir)**. Speed is similarly shown as **vitesse " dur "** and **vitesse anémométrique " sensible "**. — These artifices are used to avoid ambiguity when using a narrow film of high sensitivity.

In this example recording started as soon as weight was removed from the main undercarriage shock absorbers and stopped by the reverse movement. The flight illustrated is one of 18 successive trips by the same aircraft on European services, such as London, Zurich, Geneva, Stockholm. It will also be noted that " coarse speed " and " fine altitude " increase from bottom to top, while " coarse altitude " and " fine speed " move in the opposite direction. This arrangement was adopted to avoid ambiguities in reading.

A first reading reveals that the climb was made on a heading close to that of take-off at an air speed of 145 knots with a peak of 180 knots during the turn which brought the aircraft, still climbing, on to its cruising heading. The maximum altitude reached was 16,150 ft., followed by an increase in speed to 205 knots which is indicated by a drop in altitude from 16,150 ft. to the cruising altitude of 15,500 ft. The operation of the undercarriage **(train)** and flaps **(volets)** during the approach to Zurich can be seen. The recording also shows that no incidents occurred during the flight.

Recording I, for a normal commercial flight from Paris to Zurich.



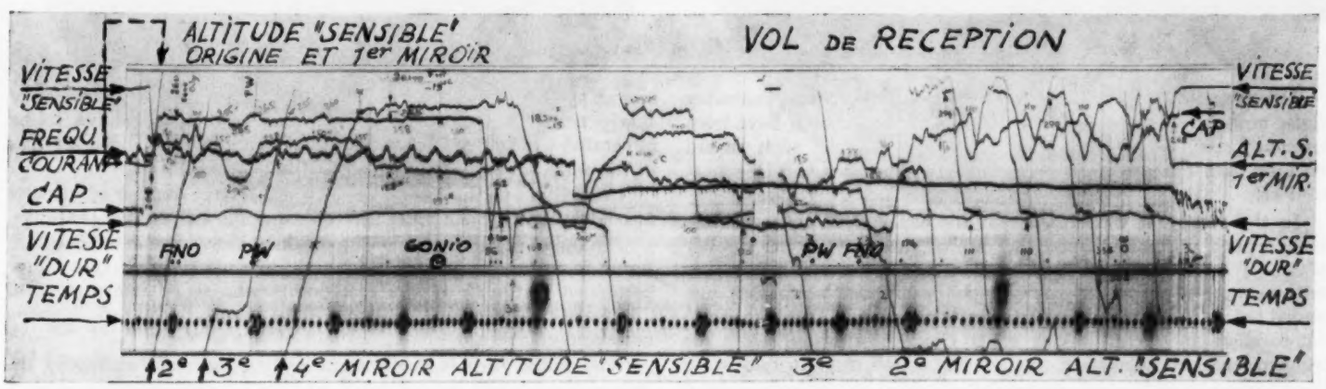
rarely need to prepare a complete reconstruction of the aircraft's track.

At first glance such reconstruction—the second stage in the interpretation of the films—may appear simple. In reality experience has shown that the reconstruction of a curve starting from the tangent to each point involves considerable risk of error and necessitates a degree of precision in the heading which is difficult to obtain in practice, since the recording error is at least equal to the compass error. Moreover, an exact reconstruction presupposes knowledge of the ambient temperature and above all of the wind at every point. This problem probably cannot be solved unless radio information (e.g., of the passage of an aircraft over beacons) can be used to rectify the reconstructed track from time to time. The systematic recording of an aircraft's passage over beacons thus appears to be an essential condition for the detailed utilization of navigation data, such as would be needed in certain cases, for example, in investigations of accidents.

*

It can already be said that, once an airline has regularly made systematic recordings of navigation data, it will not willingly dispense with them.

SECOND PRACTICAL EXAMPLE



Recording II, for the acceptance flight of a four-engined commercial aircraft from Paris-Orly to the neighbourhood of Avranches (Normandy) and back (via Villaroche) to Orly.

Recording II is that of an acceptance flight by a four-engined aircraft after a major overhaul.

Not all the details of the experiment appear in the recording, but the commentary given attempts to show the relation between the operations carried out by the crew and the variations in the values recorded.

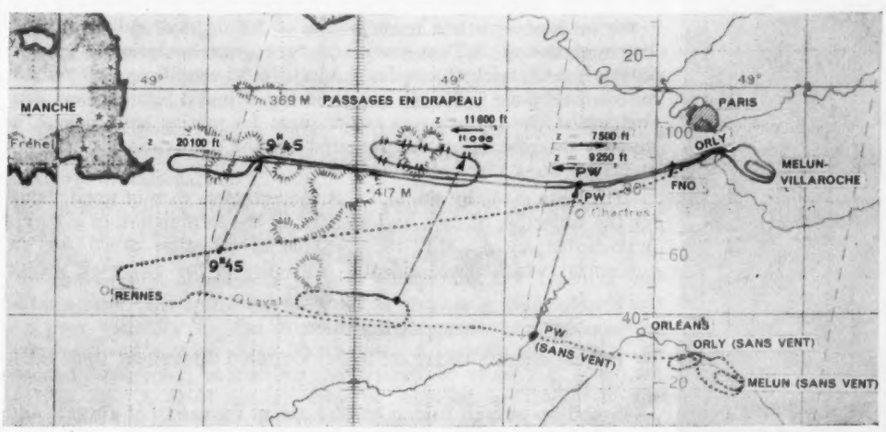
The dotted line on the map reconstructs the aircraft's course through the air, and the continuous line its course in relation to the ground. Operations at Melun-Villaroche included three simulated baulked landings, each complicated by an engine failure.

In addition to the values automatically recorded (altitude, air speed, heading), the following were available: extreme temperatures noted by the crew during the flight, ground references provided by the Orly radio beacon (FNO) and the West gate (PW), and bearings on two stations at 09.45. Special features, the time of which it was desired to note, were also recorded. The actual course above ground was reconstructed from the air course and the ground references flown over.

In contrast to the previous case, the recorder was set in operation when the doors were closed. Consequently each time the wheels touched the runway during the baulked landings at Melun-Villaroche the heading recorded corresponds to the runway QFU.

During the flight the recordings of altitude and air speed were interrupted to enable a check to be made of the co-pilot's anemometer, while recording of the heading continued. This interruption took place at 10:30.

Reconstruction of the ground course for the flight covered by recording II.



Examination of the film shows that the aircraft began to climb immediately after take-off from runway 26 at Orly. A first special marking was recorded over FNO radio beacon, and an altitude of 8,000 ft. was maintained for a little more than three minutes up to passage over beacon PW. Then the climb was resumed to an altitude of 20,100 ft. on a heading that varied slightly around 260° and at an air speed between 185 and 200 knots. D/F bearings were taken at 09:45, the aircraft began a series of manœuvres at 09:51 and then at 09:57 began to descend on a heading of 108° to 11,000 ft. (10:08 hrs.).

At 10:10, after a turn onto a course of 270°-280°, each engine was cut out twice in turn, with its propeller being feathered once manually and once automatically. Each of these operations can be seen on the curve representing the variations in the frequency of the 400 cycles current. Each cut-out and restart is marked by a rapid but weak oscillation in frequency. The total width of the film represents 50 cycles. During these operations the aircraft changed course through 100°, 90°, 100° to 80°, passing over PW at 10:36 and FNO at 10:43. Immediately afterwards it set course for Villaroche, where the "baulked landings" were made. The latter are indicated by the altitude, air speed and heading curves and by the jerks in the frequency curve.

The example shows the necessity for supplementing the recording of altitude, air speed and heading by information provided by the ground radio service.

The Airfield Surface Movement Indication Radar at London Airport

BY CHARLES BOVILL, A. M. I. E., M. BRIT. I. R. E. A. F. R. Ae. S., LONDON

The author has been engaged in aeronautical radio and radar engineering since 1935, having started with the British Air Ministry and later joined the Marconi Co.'s Air Division. He has been mainly occupied with air-borne experimental and field trial work in connection with aircraft aerial systems, communication systems and navigational aids. He served with the R.A.F., in command of Air Operational Group, Inter Services Research and later with the Balkan Air Force. He joined the Decca Navigator Co. in 1946 and did much of the pioneering work in the development of the air side, notably in France, and later worked on the building and putting into service of the French chain. In 1953, he joined Decca Radar Ltd., and with this company specialises in radar aids to aviation.

Although the Decca Q Band Airfield Surface Movement Indicator Radar now installed at London Airport is the first one to have been developed specially for this purpose, the necessity for such an aid has long been recognised and was the subject of an I.C.A.O. report in 1947.

In this report, it was stated that the capacity of an aerodrome must depend ultimately upon the rate of clearance of the runway in use. Today, this is still true, and in the interests of safety it is still essential to clear the runway of the aircraft which has just landed before the next one can be permitted to land. It is also essential to allow an aircraft taking off to clear the runway before the following one can be allowed to start its take-off run. In both cases the speed of movement of the aircraft whilst it is on the runway is considerably slower than when it is airborne and it is necessary for the ground movement to be carried out as rapidly as possible, since any delays at this stage can have their repercussions throughout the system from the holding stack to the unloading point.

There is a further factor to be considered. Certain of the larger aircraft are obliged to have imposed upon them low altitude minima for overshooting and a " point of no return " in the sequence of the pilot's landing procedure. Thus it will be appreciated that ground movement delays not only interrupt airline schedules but can also introduce a hazard.

At London Airport the question of ground movements is rendered more complicated than at other airports because of its particular layout, having the loading and unloading areas in the centre of the aerodrome and the maintenance hangars on the periphery. This presents special control problems connected with the movement of aircraft between the maintenance and central areas, since these aircraft, which are usually being towed, must of necessity move very slowly across runways and along taxiways and they have to be integrated with the movements of other aircraft on scheduled services in the same areas.

Fig. 1. Aerial photograph of London Airport.

In addition to this traffic there is also a large number of vehicles to be dealt with which must traverse runways and use the taxiways.

A number of different ways of checking the movements of surface traffic have been suggested from time to time. Among these have been men stationed at strategic points who signal information to Control of the movements of traffic, light beams, traffic pads, ignition noise and engine noise detectors and of course, radar.

At London Airport much has already been done to simplify the task of the Ground Movements Controller. A comprehensive system of signposting and lighting has been established which has been in operation for some years. Under conditions of poor visibility, the procedure is for the pilot of an aircraft to report his ground movements by radio telephony but this can cause delays, such as when for instance the aircrew are all engaged in the manoeuvring of the aircraft on to the taxiway and are late in signalling their aircraft's position. There is also the ever present possibility of error in the position report.

A. S. M. I., the Radar Solution

Because of the difficulties in controlling ground movements and the paramount importance of keeping the traffic moving rapidly, the Ministry of Transport and Civil Aviation has carried out a very thorough study of methods, backed by extensive experimentation. Among these methods, radar was inevitably given consideration. The A.S.M.I. recommended by I.C.A.O. in 1947 would probably not have been possible to make with the technique which existed at the time, as it called for a discrimination of the order of 0.3 degrees in azimuth and of the order of 15 m in range, together with a range of 5,000 m. Over a long period the M.T.C.A. nevertheless carried out tests with commercially available radars, in co-operation with the British radar industry. As an example of the radars tested was a Marine Radar with a beam width of 1.8 degrees and azimuthal discrimination of 2.25 degrees and range discrimination of about 45 m. Results with this radar, under typical conditions, with a 0.1 microsecond pulse width, are shown in Fig. 2, and it is at once evident that whilst the performance is adequate for marine applications, a superior discrimination was required for the observations of movements on the surface of an airfield.

The tests made by the M.T.C.A. nevertheless were of great value for the collection of data and assisted in the formulation of a specification for an A.S.M.I. radar. This specification called for an equipment which could aid the controller in the following ways:

— Enable landing aircraft to be observed whilst they were on the runways and when clearing them.

— Enable aircraft taking off to be monitored throughout their take-off runs.

— Speed up aircraft taking off and aid in the safety of aircraft and vehicles crossing taxiways and runways.

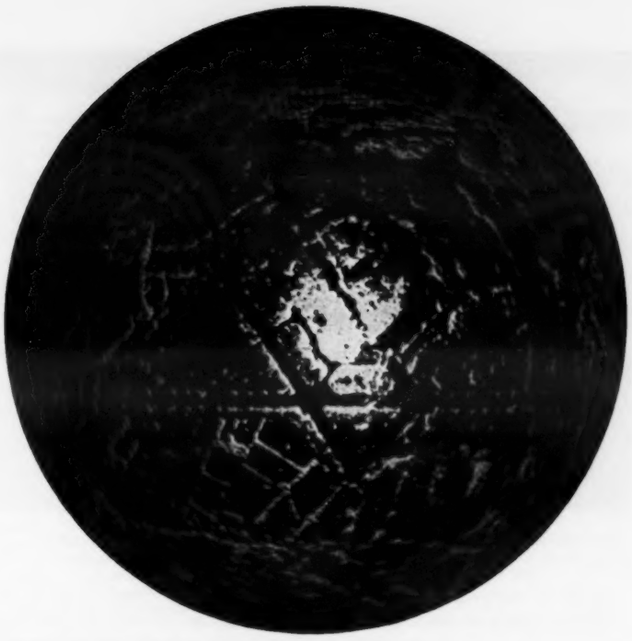


Fig. 2. Marine Radar picture of London Airport.

Fig. 3. Q Band picture of London Airport.

— Enable the position of aircraft to be checked immediately before take-off under conditions of poor visibility.

— Enable the positions of taxying aircraft to be checked.

— Aid in the direction of rescue vehicles to aircraft in an emergency.

Summed up in terms of radar performance to meet these requirements, the equipment would need the discrimination originally suggested by I.C.A.O. and would have to present a picture of nearly photographic detail, an almost impossible problem to solve with X band or 3 cm radar without an aerial measuring about 10 m across. Such an aerial would be difficult to install on top of the control tower at London Airport, which position it must necessarily occupy in order to provide the all round surveillance of the airfield needed, without blind spots.

The practical solution to the problem of high range and bearing discrimination together with an aerial of reasonable dimensions evidently lay in the employment of millimetric or Q band radar. With this very short wavelength a beamwidth of 0.3 degrees can be obtained from a scanner only 2 m across and of such construction as to be readily installed on top of a control tower.

Decca Radar Limited had for several years been obtaining encouraging results with experimental equipment working on the Q band and had in conjunction with the M.T.C.A. made a series of trials, using the equipment for A.S.M.I. applications on London Airport.

The results of these trials had been so satisfactory that a fully engineered Q Band A.S.M.I., derived from the experimental model, was obtained from Decca Radar Limited and installed in April 1955 on top of the 40 metre high London Airport Control Tower and has been on test for several months.

This equipment has a pulse width of 0.05 microsecond and a beamwidth of 0.3 degrees and is providing a radar picture of a quality hitherto unobtainable.

In the Control Tower installation, two displays are provided for the A.S.M.I. radar. These use 30 cm diameter cathode ray tubes and are located in the Traffic Control Room. One display will be shared by the Ground Movements Control Officer and the Lighting and Route Control Officer, and will be used primarily under conditions of poor visibility for the observation of arriving aircraft leaving runways and moving down taxiways and crossing runways. The second display will be used for the observation of aircraft which are taking off. A third display may be installed eventually in the Approach Control Room for use in conjunction with the Precision Approach Radar and I.L.S.

THE RADAR EQUIPMENT

Aerial System

The aerial consists of a double cheese about 2m across, which is rotated at a speed of 20 to 24 r.p.m. The pulse peak power is 15 kW, the wave length 8 mm. The horizontal beam radiated by the aerial is of the order of 23 minutes and the vertical beam is 14 degrees in depth, these figures being for half power points. The side lobes are 20 db down on the main beam on inner side lobes and better than 26 db on the outer side lobes.

The aerial is in two sections; the one cheese being for transmission and the other for reception. This arrangement reduces losses and improves performance at short range, as it eliminates the necessity for a TR cell and its attendant decay time.

The transmitter and receiver units are housed in watertight compartments beneath the aerial and rotate with it. This permits of very short runs of waveguides and reduces losses. Power supplies and various other circuits are fed to the rotating head through slip rings, and the intermediate frequency signals pass through a rotating transformer to the main receiver unit, which is designed for wall mounting and installation at some convenient location for servicing.

Transmitter, Receiver and Displays

The Magnetron used in the Decca Q Band radar is of British manufacture and is a type VX5027. It has to be made with very close mechanical tolerances for it to operate correctly and being sensitive to mismatch, it is necessary for the waveguides associated with it to be made exceptionally accurately. High tension supplies for the Magnetron are stabilised at 11 Kv.

The pulse width of the modulator is 0.05 microsecond and the pulse repetition frequency is 4,000 c.p.s., this being obtained for a blocking oscillator with a delay line arrangement.

The receiver uses a cascade preamplifier and a single ended mixer, incorporating a type VX3136 silicon detector (SIM. 8) in a waveguide section. The local oscillator is a British type VX5023 Klystron which is supplied with stabilised high tension at 2 Kv.

The intermediate frequency amplifier of the receiver employs valves of secondary emission type and a negative feedback circuit developed by Decca Radar. This circuit has the useful feature of enabling valves to be changed without disturbance of the gain or bandwidth of the amplifier. In this way the quality of the radar picture remains constant and greatly simplifies servicing.

The bandwidth of the amplifier is 20 Mc/s and its centre frequency is 60 Mc/s. The output of the amplifier is arranged to be linear or logarithmic so that the equipment can be used under a variety of operational conditions. The noise factor of the receiver is 20 db. The video amplifier has a bandwidth of 15 Mc/s and there is sufficient output from it to feed three displays.

The displays use 30 cm diameter long afterglow tubes and incorporate bearing scales calibrated in degrees and variable range markers. A manually rotatable cursor is also fitted. Provision is made for ranges of $^1/_2$, 1, 3 and 10 miles. A non parallax plotting device, originally developed for Marine plotting can be fitted to the face of the tube if required.

The power supplies and all transformers and smoothing are designed for operation at 1,000 c.p.s. An alternator which can be driven from alternating or direct current provides about one Kw at this frequency. The pulse repetition frequency of 4,000 c.p.s. is derived from the basic supply frequency, and smoothing throughout the equipment is thereby considerably simplified.

Fig. 4. Aerial on Control Tower.

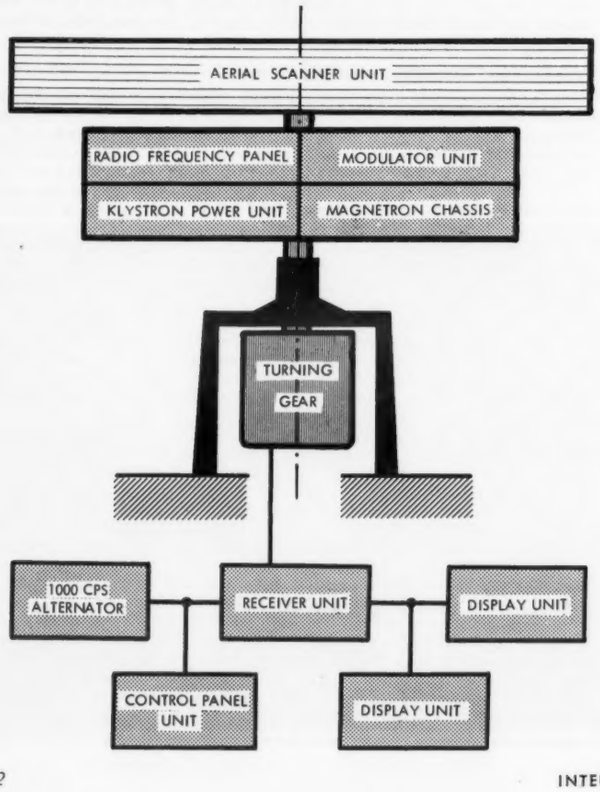
Fig. 5. Inside Control Tower, showing Q-Band Radar display (left hand, centre).

Results with the Decca Radar Q Band Equipment

To obtain an idea of the quality of the Q Band radar picture comparison should be made between the photograph on Fig. 1 of London Airport from the air, and Fig. 3 which is a photograph of the Q band radar display taken with a 16 second exposure, during a period of four revolutions of the scanner. This shows the runways, taxiways and intersections with remarkable clarity, and it should be noted that there is no echo from the runway surfaces at all, which permits of the operator seeing at once any object upon them.

Among observable details which have been seen during trials, it has been found possible to discern the three separate fins of a *Constellation* aircraft on the runways ; these are approximately 6 metres apart. It is also possible to observe pedestrians on the runways, and the driver of a tractor has been watched on the radar screen leaving his vehicle. In view of this exceptional discrimination, it is a relatively easy task to observe aircraft and vehicular traffic at any point on the aerodrome. It will be noted that the radar view of the airport is completely unobstructed and that no blind spots occur. The excellence of the paint is largely due to the virtual non-existence of side lobes which normally tend to confuse most radar pictures, particularly at close ranges. The fineness of the detail immediately beneath the site of the radar installation is due to electronic circuits for the prevention of overload in the equipment, the 14° deep beam and to the elevation of the aerial above ground. On measurement the discrimination is found to be of the order of 6.0 metres in range and better than 0.3 degrees in azimuth.

Fig. 6. Block diagram of the Decca Q Band radar.



The presentation of various types of traffic is interesting. In many cases the return from an aircraft shows a picture that is easily recognisable as an aircraft and which is much as it would appear on a map of a scale of one in 12 thousand, when on the one nautical mile range normally used for runway observation.[1] In Fig. 3 the difference between slow moving and fast moving aircraft can be examined. On the East West runway on the bottom of the picture, spaced echoes can be seen, which are returns from an aircraft taking off. This spacing characterises a fast moving aircraft, whereas on the North South runway to the right of the picture, a series of closely spaced echoes will be seen, due to an aircraft taxying.

This distinction between fast and slow moving aircraft is an important operational feature of the radar and is, it will be understood, a function of the speed of rotation of the scanner. The 24 r.p.m. at which the scanner turns is considered to be the best speed to enable the operator to distinguish at once the difference between fast and slow moving objects.

On the East West runway at the top of the photograph in Fig. 3 a return from a vehicle will be noted and it will be seen that it is different in appearance from a return from an aircraft.

The maintenance area to the East of the runways and to the right centre of the photograph in Fig. 3 can be observed clearly, and a number of aircraft can be seen in front of the hangar. These aircraft are B.E.A. *Viscounts* and *Elizabethans*.

In the terminal area, aircraft, vehicle and even pedestrian echos can be seen, also clear returns from street lighting lamp standards to the North East of the centre of the picture. To the North of the aerodrome, the Great West Road can be traced, together with the small trees which line it and vehicular traffic proceeding along it.

*

In conclusion, it can be said that the radar appears to have the performance required and that it very fully meets the recommendation of the C.O.T. division of I.C.A.O. which called for a radar which would ensure that " the display shall be such that the Controller can instantly distinguish such fixed objects on the aerodrome as may be of no immediate interest to him and aircraft, other vehicles and objects, moving or stationary which are of significance to the control of traffic ".

[1] Under these conditions the size of the 30 cm screen is approximately equal to a scale of 1/12.000.

The Mind of Mr. Reader

Blind-Flying " Staggers " ?

Sir,

For some time several of my colleagues and I have been discussing the problem of " blind-flying staggers " (Ed. : in German, *Blindflugkoller*), its origin and consequence, namely, descent in a continuously tighter and more steeply banked turn. One of my friends and myself have been pilots for some time but have never heard an explanation of these reported " staggers ". Since all of us are avid readers of *Interavia*, we wish to inquire whether such problems are discussed in your column, " The Mind of Mr. Reader ".

Willi LEUENBERGER

Gerlafingen, Solothurn, Switzerland.

The Editors are not familiar with the expression " Blindflugkoller ". The description of these staggers suggests that the blind-flying situation involved is that of a continuous horizontal loop, in which the aircraft, with wings almost vertical, rapidly loses height in a tight, steep spiral at great air speed and very high stick forces. This situation can arise inadvertently through lack of experience of blind-flying. It is recognizable from the fact that the sphere of the turn-and-bank indicator shifts to the inner extremity of its arc, whereas the needle indicates only a slight deviation in the *same* direction. Such a manoeuvre is flown practically on the elevator alone at an extreme banking angle, the elevator therefore acting as the rudder. If the pilot, unaware of his real flying attitude, now attempts to reduce speed by " pulling-out ", he only tightens his curve and increases the danger of the situation. Glancing at the dashboard, he obtains the impression that his instruments have " gone wild ".

— Ed. —

* ! ; & ? : $ % * £ ! . . .

Sir,

Re : Reports by the AM aviation transmitter

Permit me to enquire whether you are aware of the activity displayed by the AM aviation transmitter.

This transmitter regularly broadcasts news on so-called aeronautical AM radiations (direction of rays, intensity, zone scatter). Curiously enough, each forecast of AM series radiations is followed by aircraft accidents with not clearly defined origins. For example :

August 5th, 1955, at Rolla, U.S.A., civil aircraft

August 23rd, 1955, at Landsberg, Germany, military aircraft

November 20th, 1955, at Iwojima, Pacific, military aircraft.

These cases have previously been reported to the *Deutsche Luftfahrtgesellschaft* (? Ed.-), Brunswick, and to the American air intelligence service, Munich.

It is clear, no doubt, that both organizations observed strict silence as long as the origin of the transmitter could have been detrimental to the general policy of peace. In the course of a statistical comparison covering the past three months it has now been established beyond doubt that no preferential treatment is accorded to Eastern wavelengths, so that the broadcasts are unlikely to be formed of official Russian news.

A step-by-step exposure of the AM news would probably not lead to any suspicion being cast on any nation. On the contrary, in my opinion any unbiased observer must be particularly interested in a peaceful exposure to the benefit of general security.

May I therefore respectfully request the Editors, of whose well-known neutral attitude I am aware, to comment on their point of view regarding this exposure in a civilian form... An international commentary of this sort would seem to be all the more important as the transmitter has forecast new AM radiation irruptions for the month of February...

Alexei FILONENKO,
Intelligence Agent

Munich, Germany.

Quite. — Ed. —

Professor Einstein's " Folly "

Sir,

According to your contributor, Mr. G. Erhardt (" Interavia ", September 1955), Professor Einstein's " document " dates back to 1917. Unless all the signs are wrong, Einstein's " unknown document " in turn has had a history. For, a full year earlier, in *August 1916*, Professor Einstein published a paper entitled " Elementary Theory of Water Waves and Flight " in the well-known German magazine *Die Naturwissenschaften* (No. 34, pp. 509-10), of which a copy is enclosed. The three final paragraphs seem to contain all that is worth knowing concerning the aerodynamic history of the " cat's back airfoil " in question...

When, more than two decades ago, I passed my examination on the subject of " Technical Flow Theory " I was also questioned on the generation of lift in aircraft. I first answered the question as we had been " drilled " at school but added that Professor Einstein had also given an " explanation " of the generation of lift. My teacher obviously was unfamiliar with Einstein's article, for he asked me in which publication it had appeared.

When I read the article in *Interavia* the other day, I remembered Einstein's paper which no doubt forms the aerodynamic " history " of the " cat's back airfoil "... It is certainly accurate that, towards the end of his letter to Mr. Erhardt, Einstein wrote that he had got stuck with his " first idea ", in other words, he still adhered to thoughts of the kind he had expressed in his Article of 1916. For in the meantime *much greater ideas* had no doubt taken the place of this aerodynamic thought. A glance at Einstein's bibliography shows that the great scientist had published no less than 15 works in 1916, including for the first time his " Basis of the General Theory of Relativity ".

That Einstein devoted any time to the problem of flight is perhaps due to an " inspiration " of the scientist, unless an acquaintance or a third person had requested him to comment on the problem... As regards Einstein's article of 1916 it should be added that nothing in the trade literature of that time gives an indication of any polemic by the then *leading* aerodynamicists against Einstein's train of thought or " conclusive demonstration ". Not a single critical voice was raised against him in expert circles... A glance at the literature on the subject reveals that especially in the study of lift and the lifting capacity of the wing the *hydrodynamic principles* formed the " point of departure ". It might be recalled here, for example, that the well-known Stuttgart " mechanic ", Professor Richard Grammel, published a paper in 1917 under the title " The Hydrodynamic Basis of Flight ".

I hope that these " *complementary* " remarks have entertained you...

Göteborg, Sweden — M. GUTMANN

The last three paragraphs of Professor Einstein's article in " Die Naturwissenschaften ", No. 34, pp. 509-10, 1916, are reproduced herewith :

" Let a fixed cylindrical wall, with a bulge upwards, be set up in a fluid or air flow, at right angles to the plane of the paper. If there were no bulge, no force would be exerted on the surface apart from the effects of unavoidable friction. The bulge, however, will affect the fluid flow above and below the wall, thus producing pressures.

" In the underneath flow the bulge results in a local increase in section, i.e., in a slowing down of the flow and hence positive pressure. On top, however, the bulge reduces the flow section, thus accelerating the flow and producing a negative pressure. The dynamic pressure forces initiated by the flow thus produce an upward force acting on the wall. In order to obtain this force it is obviously only necessary to have a portion of wall large enough to cause an effective bulge in the fluid flow. We thus have before us the supporting wing of a bird hovering without beating its wings or of a flying machine.

" From this simple example it will be seen that the only work required to fly is that needed to overcome the unavoidable frictional drag. If there were no friction, a bird could fly any distance horizontally without work ".

— Ed. —

Atlas Aérien (Volume 1). — By Pierre Deffontaines and Mariel Jean-Brunhes Delamarre, maps by Jacques Bertin. — Gallimard, Paris, 1955 (French, 191 pages, 209 aerial photographs, 5 maps).

This excellently compiled air atlas of the French Alps, Rhone Valley, Provence and Corsica is the first volume in a collection which the authors plan to extend to the whole of France. An imposing project, the amount of work involved in which can be judged from the fact that the 209 photographs used were selected from among more than 30,000. The authors have made only modest use of existing material (the official records of the Institut Géographique National), firstly because they prefer oblique rather than vertical photographs as being more easily appreciated by the unaccustomed eye and providing a better picture, and secondly because they wished to make their selection as individual as possible. For the latter reason the same scenes are shown at different times of the day or year and in different weather conditions. The excellent relief map included for each region, showing the corresponding sections photographed, considerably facilitates orientation. When the whole collection is complete the French will have a first-class air atlas of their country.

He.

Weltflieger, Erinnerungen 1926-1947. — By Wolfgang von Gronau. — Deutsche Verlags-Anstalt Stuttgart, 1955 (German, 318 pages).

Thirty years ago a flight from Europe to America was a daring feat and a round-the-world flight an adventure. Wolfgang von Gronau, the only surviving German pilot from the

Atlantic pioneer days, who alighted in New York harbour in a Dornier Wal in 1930 and two years later was the first German to fly round the world, has now published his memoirs. The chief incidents described are a flight to Greenland, the New York trip and the round-the-world flight. Written in a lively, graphic manner, they paint for the reader a rich canvas of encounters with people of many different nations, from the highest to the lowest. The last part of the book covers the years 1939 to 1947 which von Gronau spent as German Air Attaché in Tokyo. The account of his experiences in Japan, Manchuria, China and the Japanese war theatres have a high historical and documentary value. It ends with the collapse of Japan and von Gronau's homeward trip aboard an American troop transport. — A book for young and old, particularly for the youth of Germany. Ha.

Principles of Helicopter Engineering. — By Dipl.-Ing. Jacob Shapiro. Temple Press Ltd. (in association with " The Aeroplane "), London, 1955 (English, 448 pages, 350 illustrations, index, price 55 shillings).

The Polish-born British author obtained his engineering diploma at the Zurich Federal Institute of Technology. He played a leading part in the development of the Cierva W.9 and *Air Horse* helicopters and is today an engineering consultant. Shapiro is classed as one of the leading experts on helicopters, and his present comprehensive, detailed book does his reputation full honour. The book is divided into six chapters : 1. Rotating Wings in Steady Flight ; 2. Performance of Helicopters ; 3. Dynamics of the Rotor ; 4. Mechanics of Helicopter Flight ; 5. Helicopter Projects ; 6. Rotorcraft Components and Assemblies. — The in part " heavy diet " of mathematical formulae is lightened by explanations, drawings, diagrams and tables and rendered digestible by exact definitions of the terms and symbols used. Though addressed primarily to the helicopter designer, Shapiro's book also offers the interested layman a wealth of information. Ri.

Moderne Luchtstrijdkrachten, Vliegtuigtypen etc. (Second, revised edition). — By Hugo Hooftman. — N. V. Uitgeverij " De Kern ", Amsterdam, 1955 (Dutch, 56 pages).

The object of this small volume is to introduce the reader to a number of modern combat aircraft of the U.S., British, Russian and Dutch Air Forces. Each class of aircraft (fighters, bombers, reconnaissance aircraft, etc.) is dealt with in a separate chapter, which facilitates comparison. Further chapters discuss guided missiles, vertical take-off and landing and armament questions. Ha.

Helicopters, Ontwikkeling en Toekomst, Constructie en Besturing. — By J. C. P. Stuy. — N. V. Uitgeverij " De Kern ", Amsterdam, 1955 (Dutch, 56 pages).

Beginning with a historical review of the first rotary wing designs, the author gives a brief survey of the development, prospects and limitations of the helicopter. Problems discussed include power plant design, control, the flying qualities of various types and helicopter operation (heliports, operating costs, private operations). Forty drawings and photographs and a list of the most important American helicopter types supplement the text. Ha.

Vom Reissbrett zum Rollfeld : Super Constellation, the History of a Giant. — By Kurt W. Streit. — Union Deutsche Verlagsgesellschaft (Bücherei Neues Universum), Stuttgart, 1955 (German, 75 pages).

The development of a modern long-range transport is here described through the example of the Lockheed L-1049G *Super Constellation.* The author has succeeded in describing the various phases of development in a form that is not only easily understandable but gripping. Thirty-two excellent works photographs supplement the text ; the introduction was written by Wolfgang von Gronau. Ha.

Sport- und Reiseflugzeuge (Vol. 1 in the " Flieger " series *Flugzeugtypen*). — Published by Luftfahrt-Verlag Walter Zuerl Munich, 1955 (German, 110 pages, DM 2.50).

This book gives the sports flyer in condensed form the most important data (including price) of 50 sports and touring aircraft from seven different countries and provides a number of valuable hints on the purchase of aircraft. Re.

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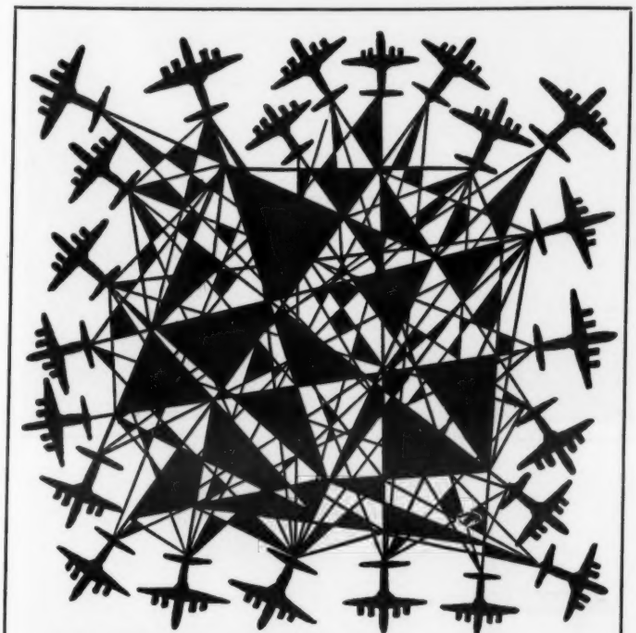
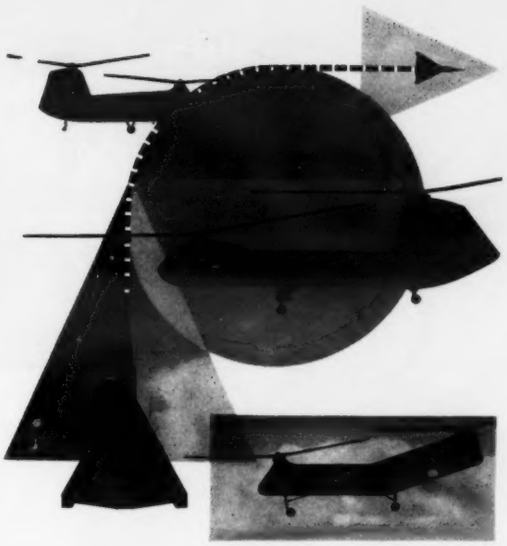


ANY SKY... FLY

LAI

DOUGLAS DC-6B
CONVAIR LINERS

ITALIAN AIRLINES



NEW SHAPES

of things to come from Piasecki ...

Startling new flight concepts are taking shape on the drawing boards—in the test cells—of the Piasecki Research and Development Division.

New airfoils, new control devices, new lift configurations—these are the building blocks of future Piasecki developments.

Looking to the immediate future, progress has already been made in Vertical Takeoff aircraft. New and improved helicopter designs—projections of Piasecki's long research and engineering experience in high performance helicopter design and production—are nearing the flight stage.

Today, many different models of Piasecki helicopters are flying for the three Armed Services . . . everywhere . . . doing dozens of difficult jobs. Tomorrow, the shape of Piasecki aircraft to come will be a vital part of our Defense picture, our air transport scene.

In the future, as today, Piasecki will design and build aircraft for performance, for versatility — *for the toughest jobs.*

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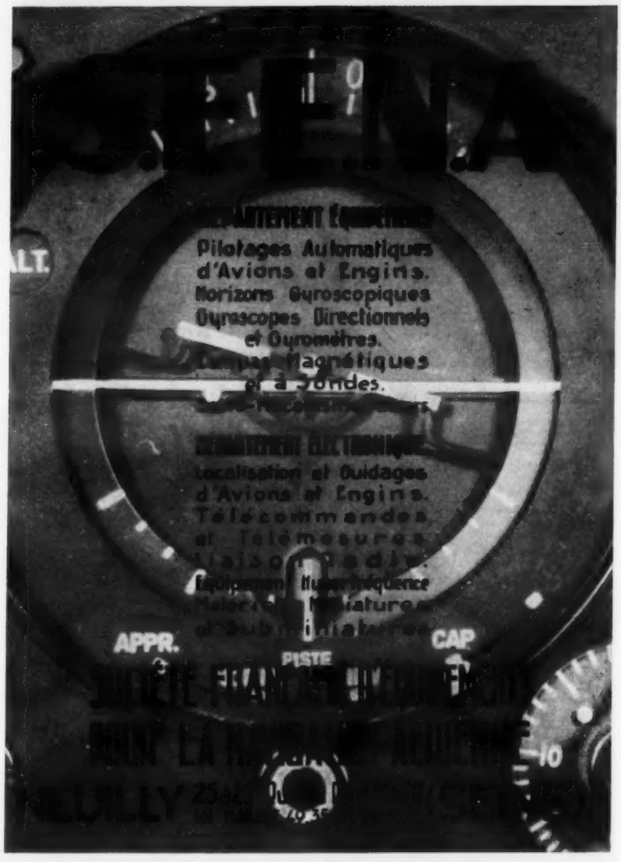

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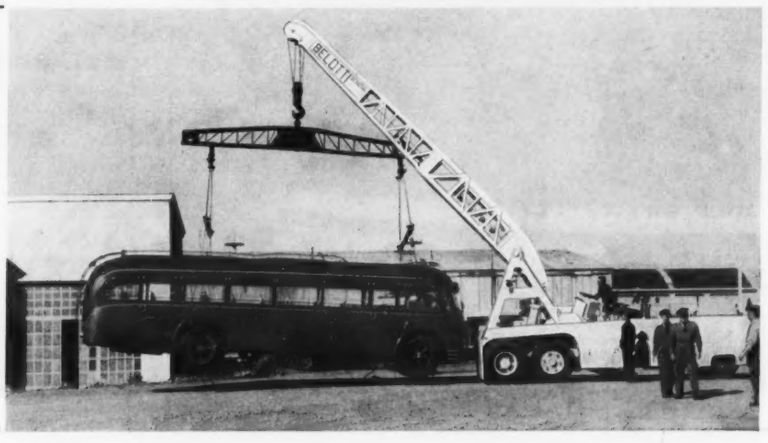

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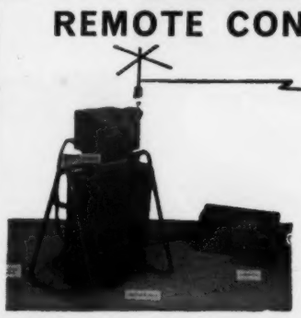

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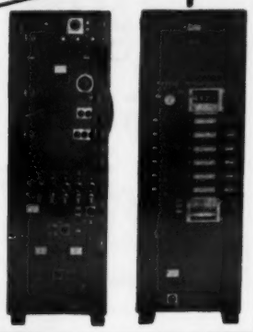

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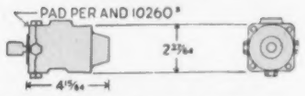

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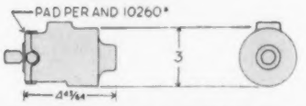

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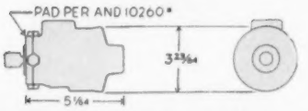

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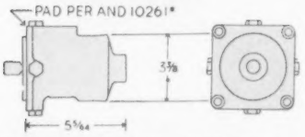

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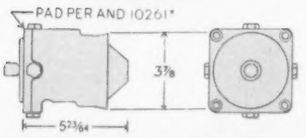

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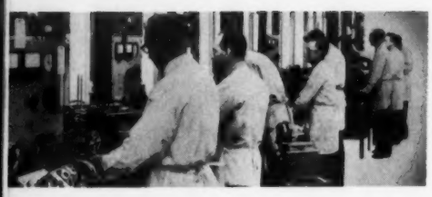

This roster of Lear aviation products is, of necessity, incomplete. Many of these products are frequently combined to form an infinite variety of additional products or systems. Only enough typical devices are shown here to demonstrate Lear's mastery of a field of science and technology that uses thousands of such building blocks for meeting the highly specialized requirements of modern aircraft and missiles.

δ *flight control systems*

- Automatic altitude controllers
- Automatic approach couplers
- Automatic Mach number controllers
- Automatic pilots (lightplane)
- Automatic pilots (high-performance)
- Automatic pitch, yaw, and roll dampers
- Automatic rudder controllers
- Automatic wing flap systems
- Missile control systems
- Test equipment

σ *flight reference systems*

- No-gimbal-lock vertical gyro indicators
- Stable platforms
- Test equipment
- Three-axis gyro indicators
- Vertical gyro indicators

γ *navigational systems*

- Automatic radio direction finders
- Glide slope receivers
- High-latitude gyro compass systems
- Integrated ADF-magnetic compass systems
- Localizer receivers
- Marker beacon receivers
- VHF Omnirange receivers

ξ *electro-mechanical systems*

- Artificial feel systems
- Camera positioners
- Canopy control systems
- Carburetor air door controllers
- Cowl flap positioners
- Convertiplane rotor positioning
- De-icing valve positioners
- Engine throttle controllers
- Gas, hydraulic, fuel, valve positioners
- Inlet screen retraction systems
- Inlet vane angle controllers
- Jettison systems
- Landing gear lock systems
- Mechanical advantage ratio changers
- Oil cooler flap controllers
- Parachute door systems
- Precision remote positioning systems
- Supercharger blower shifters
- Test equipment
- Throttle friction controllers
- Trim tab positioners
- Turbo-prop clutch valve controllers
- Wing flap positioning systems

λ *electro-mechanical components*

- Linear actuators
- Rotary actuators
- Servo actuators
- Power units
- Actuator controls
- Alternators
- Capstans
- Freewheeling clutches
- Friction clutches
- Magnetic clutches
- Slip overload clutches
- Electromagnetic brakes
- Flex drive H's, hex's, L's, and T's
- Flexible shafts
- Gearboxes
- Handcranks
- Motors (AC and DC)
- Enclosed fan motors
- Explosion proof motors
- Gearhead motors
- High frequency motors
- High temperature motors
- Miniature motors
- Pneumatic motors
- Servo motors
- Torque motors
- Screwjacks
- Load limit switches
- Position limit switches
- Programming switches

ζ *instruments*

- ADF indicators
- Attitude indicators, 2-axis
- Attitude indicators, 3-axis
- Directional indicators
- ILS indicators
- Integrated ADF-magnetic indicators
- Trim indicators
- Tuning meters
- Omnirange indicators

μ *instrument components*

- Altitude transducers
- Vacuum tube amplifiers
- Magnetic amplifiers
- Printed and etched circuit amplifiers
- Transistor amplifiers
- Displacement gyros
- Dynamic pressure transducers
- Gravity-sensing switches
- Magnetic modulators
- Magnetic powder clutches
- AC and DC servo motors
- Electric gyro motors
- Flag motors
- High-frequency motors
- Torque motors
- Power converters
- Rate generators
- Rate gyros
- Resolvers
- Synchros
- Synchro repeaters

ψ *communications systems*

- UHF, VHF, HF, MF, and LF receivers
- VHF transceivers
- VHF, HF, and MF transmitters
- ADF receivers
- Airport traffic transceivers
- Monitoring transceivers
- Portable transceivers
- Telemetering receivers
- Test equipment

ε *communications components*

- Audio frequency amplifiers
- Vacuum tube amplifiers
- Magnetic amplifiers
- Power amplifiers
- Printed and etched circuit amplifiers
- Transistor amplifiers
- Aircraft broadband antennas
- Ground plane antennas
- LF-MF whip antennas
- Loop antennas
- Mobile antennas
- Trailing wire antennas
- UHF-VHF whip antennas
- VHF Omnirange antennas
- Antenna fairleads
- Antenna reels
- Antenna tuning coils
- Cable assemblies
- Coil assemblies
- Crystals
- Dynamotors
- Headsets
- Loudspeakers
- Amplifying loudspeakers
- Noise-cancelling microphones
- Radio noise filters

η *fluid handling equipment*

- Absolute pressure switches
- Bombsight and instrument desiccators
- Canopy seal pressurizing kits
- Cooling units for electronic assemblies
- Dehydrators
- Fuel flow dividers
- Pneumatic actuators
- Pressurizing control panels
- Alcohol pumps
- Anti-detonant injection pumps
- Ballast pumps
- Bilge and refueling pumps
- Dry air pumps
- Electric motor driven pumps
- Ethylene glycol and coolant pumps
- Ethylene oxide pumps
- Fuel pumps
- Fuel booster pumps
- Fuel filter de-icer pumps
- Fuel transfer pumps
- Hand operated pumps
- Heater fuel pumps
- Hydraulic pumps
- Hydraulic oil booster pumps
- Hydrogen peroxide pumps
- Lube oil and scavenge pumps
- Multiple-element pumps
- Oil transfer pumps
- Scavenge pumps
- Smoke pumps
- Submerged fuel booster pumps
- Vacuum pumps
- Water pumps
- Radar pressurizing kits
- Air relief valves
- Check valves
- Hydraulic valves
- Hydraulic servo valves
- Pressure regulating valves

φ *test equipment*

- Bench test cable assemblies
- Electronic test sets
- Field strength meters
- Pressurizing test kits
- Universal electro-mechanical test stands
- Universal motor test stands

π *miscellaneous*

- Airborne television installations
- Airplane brake modernization kits
- Auxiliary power supplies
- Electronic chassis assemblies
- Executive airplanes
- Periscope prism selectors
- Precision remote positioners
- Printed circuits
- Radomes
- Wire harnesses

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